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Psychology and Life

7TH EDITION

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University of
Southern California*

REFERENCE MANUAL

PSYCHOLOGY
IN NATURE

William L. Ruch

PSYCHOLOGY
IN SOCIETY

Robert Rosenthal
Neal E. Miller
Jane Loevinger
James L. McGaugh
John W. Senders
Herbert C. Kelman

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Preface

A hundred years ago Thomas Carlyle had this to say: "Today is not yesterday; we ourselves change; how can our works and thoughts, if they are always to be the fittest, continue always the same?"

This Seventh Edition of *Psychology and Life* has changed in step with the times. Yet the basic purpose and approach have not changed. In the First Edition the author attempted to write a textbook that would introduce students to psychology in an interesting and life-related way, yet without sacrifice of scientific rigor. This same principle has governed the preparation of the present edition.

For the author, each edition of *Psychology and Life*, as compared to the preceding one, has been both an easier and a harder task—harder because there is so much current literature to be evaluated but easier because this vast storehouse of facts and principles of psychology contains many more scientifically sound findings to answer students' questions.

This edition reflects the increased sophistication of the science of psychology and the greater precision and subtlety of the research being carried out. The presentation of research procedures and findings has been tightened and sharpened, but with care throughout to keep the human touch. Current findings in many new areas have been added, including the role of imitation in learning, possible neural mechanisms in learning and memory storage, cognitive dissonance, inhibition and excitation in the nervous system, visual pathways and receptive fields, sleep and dreaming. The "knowledge explosion" in the area of physiological psychology in the last fifteen years has produced much that is of direct relevance to a science of behavior. So the discussion of this important area has been moved from the Reference Manual into the text itself. Physiological material will be

found in the new Chapter 2, as well as in relevant locations throughout the book.

More emphasis has been put on theory, with one new section on major learning theories and another on major personality theories. Changes have been made in sequence and organization in an effort to highlight important relationships that are sometimes missed. Thus the materials on personality and individual differences have been moved forward to follow directly after the chapter on development, where their roots in the nature-nurture questions can be more clearly seen and understood. Similarly, the discussions of sensation, perception, and thinking now follow those on learning, clarifying the interdependence and continuing interaction of the several cognitive processes. The material on learning has been partly reorganized and includes a fuller treatment of operant conditioning and its applications in the fields of brain research, programed instruction, and behavior therapy.

A new section in Chapter 1 on the "three faces of psychology"—teaching, research, and application—should serve to broaden the student's orientation to psychology as a field of study and as a possible career. This section emphasizes the importance of an interdisciplinary approach, using the timely area of studies of traffic safety for illustration.

The Reference Manual chapter on statistics has been extended to include a concise introduction to analysis of variance, a tool used increasingly in psychological research. In the new edition, as in the previous one, there is a two-level handling of statistical concepts: a verbal introduction to statistical concepts in the text discussion of individual differences, with the mechanics of computations reserved for the more detailed Reference Manual treatment.

The Reference Manual also contains an all-new "Frontiers" section to which experts in six of the most active areas of psychological research have contributed. Through these articles the student can visit the outposts of today's knowledge and share the excitement of looking to see what may lie ahead.

The new edition of the *Psychology and Life* Program again includes several supplementary materials designed to increase the student's involvement and understanding. The student workbook, *Working with Psychology*, has a new co-author: Dr. David S. Gorfein of New College. It includes directions for simple experiments not requiring mechanical equipment, studies of experimental method to guide students' analyses of published studies, guided reviews of the text chapters, and self-tests with an erasing device by which the student can verify his answers immediately, thus receiving the instantaneous feedback so conducive to learning. An expanded *Instructor's Notebook* provides additional resources for the instructor and suggestions for organizing varying types of courses depending on the needs of the individual situation. Brief editions of text, workbook, and instructor's manual are also available.

A new adjunct to this edition of *Psychology and Life* is a *Self-Instructional Program in Psychology*, prepared by Dr. Norman T. Bell of Michigan State University and Dr. James G. Hunt of Ball State University. This publication covers a selection of significant concepts treated in *Psychology and Life*; it is consistent with the text in terminology and parallels its six main divisions, but within units does not always rigidly follow the same sequence of development. It offers an innovation in programing technique, incorporating summary charts of important concepts and relationships to be prepared by the student. In situations in which programed material in just one area is desired, *Basic Statistical Concepts* by Dr. Jack I. Bradley and Dr. James N. McClelland will continue to be useful.

Another addition to the *Psychology and Life* Program is an innovative set of self-teaching tests, the *Fields Teaching Tests in General Psychology*, prepared by Dr. Paul E. Fields of the University of Washington. Designed for individual study, the tests make use of Dr.

Fields' Serial Multiple Discrimination Teaching techniques—a unique combination of multiple-choice and matching association items which requires the student to organize his knowledge and make increasingly sophisticated discriminations as well as generalizations. There is a test based on each of the chapters in *Psychology and Life*, with supplementary general tests for additional practice.

At this point it is appropriate to acknowledge the numerous positive and negative criticisms and comments of the following members of our advisory panel: Dr. Jack Bradley, of Long Beach State College; Dr. Marion Bunch, of Washington University, St. Louis; Dr. George G. Cumeson, of Cabrillo College; Dr. Richard W. Husband, of Florida State University; and Dr. Philip G. Zimbardo, of New York University. These five took part in the overall planning, read and criticized the manuscript, and are responsible for much that is good in the present edition. The author alone is responsible for any errors of omission or commission in the text itself. The reference manual on statistics is the work of William W. Ruch; each of the Frontiers pieces is signed by its author.

Thanks are also due to the following individuals who read and criticized particular sections of the manuscript: Dr. Robert A. McCleary, of the University of Chicago, Dr. Theodore C. Ruch, of the University of Washington School of Medicine, and Dr. Gary Galbraith, of the University of Southern California, for assistance with the text and illustrations on the nervous system; and Dr. Langdon E. Longstreth, of the University of Southern California, and Dr. George S. Reynolds, of the University of California at San Diego, for suggestions on the operant conditioning material.

Again thanks are due to Mrs. Letha Curtis Musgrave, M.A., of Psychological Services, Inc., whose conscientious and competent assistance in developing bibliographies, checking references, and copy-reading have greatly reduced the labors of the author. My thanks go also to the many teachers who have given me the benefit of their experience with *Psychology and Life* in the classroom and to my students of the last four years, whose questions have sharpened my efforts to communicate.

F.I.R.

Contents

Part One Man Studies Himself

1 *What Psychology Is and Does* 2

The Roots of Psychology 3

Early Attempts at Explanation • Renaissance Science •
The Mind-Body Problem • Experimental Physiology •
Psychophysics • The Early Days of Psychology •
Psychology Defined • Psychology and Other Sciences

The Three Faces of Psychology 10

The Teaching of Psychology • The Application of
Psychology • Research in Psychology

Observation and Description in Psychology 20

Kinds of Observation • Observation and the Uncertainty
Principle • Operational Definitions • Logical Constructs

Methods of Study 24

Field-Study Method • Life-History Methods • Survey
Method • Experimental Method • Statistical Control
and Analysis • How Methods Supplement Each Other

Chapter Summary 35

2 *The Biological Bases of Behavior* 38

Behavior As Adjustment 39

Man Functions As a Whole in Adjusting • The Organs
of Adjustment • Stimulus, Organization, Response,
and Feedback

The Bases of Neural Functioning 41

The Sensory-Motor Arc • The Neuron

Reflex Action 49

The Disturbing System of the Spinal Cord • The
Adaptive Nature of Reflexes • Inhibition
and Reciprocal Innervation

The Brain—"The Great Ravelled Knot" 53

How Scientists Study the Brain • Main Parts of the Brain
• Localization of Function in the Cerebrum

The Endocrine System 62

The Pituitary • The Thyroids • The Adrenal Glands •
The Gonads

Chapter Summary 64

Part Two How and Why People Differ

3 *The Development of Behavior* 68

Determiners of Development 69

Heredity and Maturation • Environment and Learning •
The Question of Instinct

The Mechanisms of Heredity 74

The "Threads of Life" • Similarities and Differences in
Families • Dominance and Recessiveness • Sex
Determination • Studying Twins

Inherited Structures 77

The Nervous System • The Muscles •
The Endocrine Glands

The Course of Maturation 82

The Physiological Gradient • Motor Primacy •
Individuation

Prenatal Development 83

Stages of Prenatal Development • Techniques for
Studying Fetal Behavior • Characteristics of Fetal
Behavior • Effects of Unfavorable Prenatal Conditions

Development During Infancy 88

Physical Structure • Sensory Capability • Responsive
Capability • Early Social Development •
Speech Responses

The Influence of Environment 93

The Effects of an Impoverished Environment • The
Effects of an Enriched Environment •
Developmental Tasks

The Growth and Decline of Human

Abilities 104

The Prime of Life • Methods of Studying Growth
and Decline

Chapter Summary 108

Clinical Approaches to Personality 110

The Meanings of Personality 111

Personality As Social Stimulus Value • Personality As
Selfhood • Personality As a Complex of Interacting Traits

The Role of Theory in Understanding Personality	112
Types of Explanation • Approaches to the Explanation of Personality	
Body-Type Theories of Personality	114
Phrenology • Physiognomy • Sonatotypes	
Expressive Behavior As a Clue to Personality	117
Graphology • Other Forms of Expressive Behavior	
Personality Theory Today	119
Psychoanalytic Theories • The Analytic Theory of Jung • Adler's Individual Psychology • Organismic and Self-Actualization Theories • Stimulus-Response Theories of Personality	
Clinical Methods of Studying Personality	128
The Interview • Clues from Projective Devices	
Chapter Summary	134

5 Psychometric Approaches to Personality 136

What Makes a Good Measuring Instrument?	137
Validity • Reliability • Objectivity • Standardization • Types of Measuring Devices	
Interpreting Scores	139
The Normal Distribution • Measures of Central Value • Measures of Variability • Percentiles • Correlation	
Approaches to Personality Measurement	145
The Philosophical Approach • The Factor-Analytic Approach	
Quantitative Devices for Personality Assessment	149
Rating Scales • Behavior Sampling • Self-Inventories	
Traditional Means of Testing Intelligence	153
Binet's Early Scale • The Stanford Revisions • Performance Tests • The W.A.S.I. and the WISC • The Meaning of IQ in Terms of Behavior • Does the IQ Remain Constant?	
Primary Mental Abilities	161
Factor Analysis • Guilford's Structure of Intellect	
The Determinants of Intelligence	165
The Relative Contributions of Heredity and Environment • The Influence of Culture • Life Conditions Influencing Intelligence	
Other Abilities	170
Psychomotor Abilities • Athletic Ability • Musical Ability • Artistic Ability	
Understanding the Whole Person	174
Profiles • The Meeting of the Ways	
Chapter Summary	176

Part Three How People Change Through Learning ✓

6 Defining and Measuring Learning and Retention 180

Kinds of Learning	181
Conditioning • Discrimination Learning • Imprinting • Verbal Learning • Motor Skill Learning • Mixed Learning Tasks • Attitude Learning	
Neural Bases of Learning	200
Chemical Coding: Breakthrough or Interesting Speculation? • Where Does Learning Take Place in the Brain? • Mechanisms of Memory Storage	
Measuring Learning	205
Criteria of Learning • Learning Curves	
Measuring Retention and Forgetting	209
The Method of Recall • The Method of Recognition • The Method of Rereading • The Course of Forgetting • Do We Ever Forget Completely?	
Major Theories of Learning	214
Hull's Formal Theory of Learning • Skinner's Approach to Learning • Watson and Behaviorism • Guthrie and Contiguity Theory • Thorndike's Reinforcement Theory • Cognitive Theories of Learning • Current Trends in Theories of Learning	
Chapter Summary	218

7 The Management of Learning and Retention 220

Influence of Motivation on Learning	221
Strength of Motivation • Intent to Learn • Reward vs. Punishment • Extrinsic and Intrinsic Motivation • Stress	
Characteristics of the Material to Be Learned	225
Amount • Meaningfulness	
Influence of Prior Learning	227
Positive Transfer • Negative Transfer	
Conditions of Efficient Practice	229
Knowledge of Results • Distribution of Practice • Conceptualization and Verbalization in Motor Learning • Reading vs. Recalling • Whole vs. Part Learning • Guidance As an Aid to Learning	
Learning Under Special Conditions	239
Hypnosis • Subliminal Stimulation • Sleep • Radiation	

- Ability to Learn and Remember 243
 - Is There an "All-round" Ability to Learn and Remember? • Do Slow Learners Remember Better? • Can Ability Be Increased Through Learning? • How Does Learning Ability Change with Age?

- What Makes Us Forget? 248
 - Inadequacy of Original Learning • The Importance of Review • Interference from Later Activity • Meaningfulness and Forgetting • Emotional and Motivational Factors • Social Factors

Chapter Summary 253

Part Four Knowing The World

8 *Stimulation and Sensation* 256

- General Characteristics of Sensation 257
 - Stimulus Intensity and the Lumen • Sensory Adaptation • Retention of Sensory Experience

- Vision—The Sense of Sight 259
 - How Our Eyes Work • Visual Acuity • Color Vision • Color Blindness

- Hearing—The Sense of Sound 277
 - Physical and Psychological Bases of Sound • The Hearing Mechanism • Deafness

- The Somatic Senses 283
 - Pressure • Pain • Cold and Warmth • The Kinesthetic Sense • The Labyrinthine Sense • Somesthesis and the Brain

- The Chemical Senses 289
 - The Olfactory Sense • The Gustatory Sense

Chapter Summary 292

9 *Observation and Action* 294

- Attention 295
 - Aspects of Attention • Role of the Central Nervous System • The Direction of Attention • The Shifting of Attention • The Problem of Distraction

- Perception 300
 - Factors in the Stimulus Field • Characteristics of the Perceiver • Social Factors • Accuracy of Perception • Interaction of the Senses

- The Perception of Space 314
 - Visual Perception of Stationary Objects • Experiments with Visual Distortion • Visual Perception of Motion • Locating Stationary Sounds in Space

- The Perception of Time 321
 - Estimating Intervals of Time • Factors Affecting Perception of Time

- Reaction Time 324
 - Measuring Reaction Time • Factors Influencing Our Speed of Reaction • Perception and Vigilance

- Perception Under Unusual Conditions 328
 - Perceptual Changes After Prolonged Sensory Deprivation • Extrasensory Perception

Chapter Summary 332

10 *Thinking and Deciding* 334

- Kinds of Thinking 335
 - Autistic Thinking • Realistic Thinking • Simple Forms of Thinking

- The Mechanics of Thinking 338
 - The Role of the Brain • Muscular Activity in Thinking • The Importance of Sensory Feedback • Cybernetics

- Tools in Thinking 342
 - Imagery in Thinking • Language in Thinking • Concepts in Thinking

- Solving Problems 352
 - Trial and Error • Insight • Steps in Problem Solving • Problem Solving as "Gap Filling" • Structures • Decision Making • Individual Factors in Problem Solving

- Creativity 367
 - Characteristics of Creative People • Can Creativity Be Improved by Training?

- Information Theory 369
 - Parts of a Communication System • Signals and Noise • Feedback in Communication

Chapter Summary 371

Part Five Adjustment and Maladjustment

11 *Motivation and Drive* 374

- Goal-Directed Behavior 375
 - Explanation of Motivation • Effects of Motivation on Behavior • Patterns of Motivation

- Biological Drives 378
 - Measurement of Biological Drives • The Hunger Drive • The Thirst Drive • Air Hunger • Fatigue and the Need for Sleep • Warmth and Cold As Drives •

The Sexual Drive • Pain As a Drive • Bowel and Bladder Tensions • The Need for Contact Comfort • Biological Drives As Homeostatic Mechanisms

Psychological Motivation 395

Curiosity—The Need to Investigate • The Need to Achieve • The Power of Symbolic Rewards • The Importance of Models • Motivation and Work

Chapter Summary 412

12 Emotion ✓

414

Aspects of Emotion 415

Emotion As Conscious Experience • Emotion As Energizer

The Expression of Emotion 417

Expression and Interpretation • Patterns of Overt Behavior in Emotion

Physiological Changes During Emotion 423

Glandular Responses • The Galvanic Skin Response • Pupillometrics • Do the Physiological Changes Constitute the Emotion?

The Role of the Nervous System in Emotion 428

The Autonomic or Visceral Nervous System • Centers of Emotion in the Brain

Emotions and Health 435

Psychosomatic Reactions • The General-Adaptation-Syndrome • Pleasant Emotions and Health

How Emotions Develop 442

Early Experimental Findings • Maturation and Learning in Emotional Development • Emotional Development in Childhood • Emotional Behavior During Adolescence • Adulthood and Emotional Maturity • Emotional Problems of Old Age

Adjustment in Marriage 453

Choosing a Marriage Partner • Factors in Marital Happiness

Chapter Summary 458

13 Reactions to Frustration ✓

460

Kinds of Frustration 461

Environmental Frustrations • Personal Frustration • Conflict Frustration

The Dynamics of Frustration 463

The Motivational Nature of Frustration • Ego-Involvement

Defensive Reactions to Frustration 463

Aggressive Reactions • Withdrawal Reactions • Compromise Reactions

Neurotic Reactions 475

Anxiety Reactions • Phobic Reactions • Obsessive-Compulsive Reactions • Dissociative Reactions • Conversion Reaction • Asthenic Reaction • Depressive Reaction

Psychotic Reactions 485

Characteristics of the Functional Psychoses • Origins of Psychotic Behavior • Experimental Study of Psychotic Behavior

Alcohol, Drugs, and Gambling 494

Alcoholism • Drug Addiction • Compulsive Gambling

Chapter Summary 498

14 Mental Health and Therapy 500

The Mental Health Movement 501

Changing Attitudes Toward Mental Illness • Propylaxis • Recognition of Psychotherapy

Major Approaches to Psychotherapy 508

Directive Counseling • Client-centered Therapy • Psychoanalytic Therapy • Existential Psychotherapy • Action (Behavior) Therapy • Integrity Therapy • Briefed Forms of Psychotherapy • Special Techniques in Therapy • Common Characteristics of Different Methods • Evaluating Psychotherapy

Physical Methods of Therapy 527

Shock Therapy • Narcosis • Chemotherapy • Nutrition in Therapy • Psychosurgery

The Eclectic Approach 535

Institutional Care • Sociotherapy • Trends and Prospects

Chapter Summary 539

Part Six Psychological Factors in Social Living

15 The Individual and the Group 542

542

Competition and Cooperation 543

Is There an "Instinct" of Competition? • Effects of Competition and Cooperation • Planning for Effective Competition

Individual vs. Group Action 551

Social Facilitation • Social Interaction • The "Risky Shift"

Factors in Small-Group Functioning 552

Composition of the Group • Patterns of Communication and Organization • The Effects of Status • Group Participation in Decision Making • Group Pressures on the Individual

Effective Leadership 562

Responsibilities of a Leader • Styles of Leadership • Group Reactions to Styles of Leadership • What Makes a Good Leader? • Training for Leadership

Illegal Behavior 571

Factors in Delinquency • Recent Improvements in Treatment • Approaches to Crime Prevention

Chapter Summary 582

Communication and Persuasion ✓

584

Public Opinion Surveys 585

Conceiving the Problem • Designing the Instrument • Sampling the Population • Conducting the Interviews • Interpreting the Results • Accuracy of Public Opinion Polls • The Use of Panels

Psychological Factors in Advertising 591

Objectives of Effective Advertising • Techniques of Advertising Research • "Institutional" Advertising

Techniques of Propaganda 593

Common Persuasive Devices • Factors in Effective Persuasion • Long-Term Effects of Propaganda • Resistance to Propaganda • Brainwashing

Chapter Summary 613

The Use of Descriptive Statistics 618

Measures of Central Value • Measures of Variability • Measures of Correlation

The Use of Statistical Inference 626

Sampling • Statistics and Parameters • The Normal Distribution • Sampling Distributions • Null Hypothesis Testing • Confidence Intervals • Analysis of Variance • Analysis of Covariance • Two-Way Analysis of Variance

Frontiers in Psychology 645

The Psychology of the Psychologist 645

Robert Rosenthal

Physiological and Cultural Determinants of Behavior 652

Neal E. Miller

The Concept of Ego Development 660

Jane Loevinger

Experimental Modification of Memory Storage 666

James L. McGaugh

Human Performance 671

John W. Senders

International Cooperation and Attitude Change 677

Herbert C. Kelman

Reference Manual

Basic Concepts in Statistics 616

Psychological Measurement 616

The Nominal Scale • The Ordinal Scale • The Interval Scale • The Ratio Scale

Acknowledgments 685

References 687

Glossary 720

Name Index 741

Subject Index 749

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Part One

The breath-taking progress of physical science during the past half century has led to the development of weapon systems so powerful and so automatic in their action that there exists a possibility that two great world powers might accomplish a degree of mutual destruction which could be fatal to both. In order to survive, men must learn to understand and cooperate with other peoples. It is hardly surprising, therefore, that during the past two decades society has turned more and more to the psychologist and other social scientists for help in understanding and predicting human behavior.

This interest in explaining human behavior, however, is not a new development. In every culture and from the earliest times, man has searched earnestly for explanations of his feelings, experiences, and behavior. He has looked for answers in superstition, religion, philosophy, and finally in the scientific investigations of modern psychology. Because the question "What am I?" is so important to man's curiosity and sense of security that almost any answer seems better than none, he has often been satisfied with answers that today seem absurd. There is security and comfort in being able to say, however unwisely, "I understand myself—and you too!" Even today, when psychology and the other sciences are furnishing man with more and more information about himself, many people still cling to superstitions and "common-sense" notions that are demonstrably false, because they provide easy explanations for the complexities of human experience. While psychology is still a long way from being able to provide all the answers, one of its major

contributions has been to substitute investigation and "honest doubt" for some of the ready-made answers of the past.

In this book we will be examining the main approaches and discoveries to date in the various areas of a still very "unfinished" science. The building of a new science is a slow process in which partial understandings are constantly refined and broadened as new evidence is obtained, and in which conclusions are always tentative, pending the discovery of further information. Therein lie the fascination and the great challenge.

We shall begin by looking at the background and scope of this young but fast-growing science, and at the methods by which it endeavors to unravel the "hows" and "whys" of man's behavior. As we gain familiarity with the techniques of observation and evaluation used by the psychologist, we shall come to see just what a complex and fascinating subject he has chosen to study.

Underlying every thought, perception, and action of man is a pattern of neural activity. Human behavior depends on an ongoing process of receiving, evaluating, integrating, storing, and responding to sensory messages. Neurophysiology, like psychology, is a relatively new science, and our understanding of neural mechanisms is as yet quite limited. But important progress has been made in recent years, and before going on to our study of the dimensions of human behavior, we shall pause to see what investigators in this field have to tell us about the important neural structures and how they function as we think and feel and move.

Outline

EARLY ATTEMPTS AT EXPLANATION

RENAISSANCE SCIENCE

THE MIND-BODY PROBLEM

EXPERIMENTAL PHYSIOLOGY

PSYCHOPHYSICS

THE EARLY DAYS OF PSYCHOLOGY

PSYCHOLOGY DEFINED

PSYCHOLOGY AND OTHER SCIENCES

THE TEACHING OF PSYCHOLOGY

THE APPLICATION OF PSYCHOLOGY

RESEARCH IN PSYCHOLOGY

KINDS OF OBSERVATION

OBSERVATION AND THE UNCERTAINTY PRINCIPLE

OPERATIONAL DEFINITIONS

LOGICAL CONSTRUCTS

FIELD-STUDY METHOD

LIFE-HISTORY METHODS

SURVEY METHOD

EXPERIMENTAL METHOD

STATISTICAL CONTROL AND ANALYSIS

HOW METHODS SUPPLEMENT EACH OTHER

Chapter 1 What Psychology Is and Does

Some beginning students think of psychology as a means of influencing people, as in a political or sales campaign. Those who have spent much time in front of the television set may think of it as something that is used to help emotionally disturbed children and adults. As a matter of fact, psychology is both of these—and more.

The chances are that a very small proportion of students who study this book will ever become professional psychologists. Many will elect psychology as a major or minor subject in college but will then turn to other careers to earn a living. Most girls will elect the very important career of homemaking. You may, of course, become interested in psychology as a result of taking this first course and elect one or more advanced courses.

Whether or not you actually become a psychologist, your adult life will be touched in increasing measure by psychology and psychologists as the years go by. When you apply for a job, you will most probably be given a battery of psychological tests, since about 85 per cent of the larger companies in the United States are currently using tests as a part of their selection program (Sperber, 1964). Perhaps you will one day have occasion to consult with a psychologist. You may ask him to help you with a problem in child rearing or a problem of personal adjustment, or in another of the ways in which psychologists use their science for the benefit of society.

Those of your classmates who go into business may employ psychologists either as consultants or as salaried staff members. Those who join the armed services will, without doubt, take numerous tests developed by psychologists. Should any rise to a position of high rank in the military, they will find psychologists

in their command. Others will call upon the insights furnished by the modern science of psychology to understand why individuals, communities, and nations behave the way they do in this age of tension and conflict.

THE ROOTS OF PSYCHOLOGY

The science of psychology is a relatively new one—but there is nothing new about man's search for explanations of human behavior. His attempts to understand himself and others and the world about him have a long and interesting history. Some of the curious notions of our remote ancestors still persist among primitive peoples.

Early Attempts at Explanation

Most early peoples, unable to understand natural events, which often seemed capricious indeed, attempted to explain all occurrences as the work of spirits, good or evil. Such explanations are known technically as *demonology*. Since it seemed possible to leave one's body and visit other places during dreams or visions, the idea of a soul—usually thought of as continuing to exist after death—developed early. As culture developed, mythologies based on earthly analogies became complex and powerful, especially in the ancient East.

In the West, the ancient Greeks attained a higher culture than any previously developed, although for the most part they still based their

The two circles are in fact the same shade of gray, but they appear to be different because of their surroundings.

Around the turn of the century, at about the same time that functionalism began to thrive in America, the school of *psychoanalysis* came into existence in Europe under the leadership of Sigmund Freud, the famous Viennese physician and psychiatrist. In his attempt to find the cause and cure of personality disorders, Freud postulated the existence of *unconscious mental processes* which influence the individual's behavior in various indirect ways, even though the individual himself is unaware of them. Freud's ideas have exerted a profound influence on personality theory and on methods of treating personality disorders, but psychoanalysis has little to say about such basic problems in psychology as the nature of the learning process and the organization of human abilities. Psychoanalytic theory has frequently been criticized for the fact that it is based largely on clinical findings rather than controlled experimentation. Psychoanalysis as a theory of personality will be discussed in more detail in Chapter 4.

Few psychologists today adhere wholeheartedly to any one of these schools of thought, but probably all would recognize the contribution each school has made to broadening the viewpoint of psychology and clarifying its scientific objectives. When we try to become consistent followers of a particular system or school of psychology, we find principles that are in conflict with those of consistent followers of another school. Some psychologists meet this situation by treating the findings of research in the manner favored by Procrustes, the robber of ancient Attica who placed all who fell into his hands upon an iron bed. If they were longer than the bed, he cut off their feet; if too short, he stretched them to fit it.

The middle road of *eclecticism* has been called the coward's way—a coward's way of avoiding head-on clashes with any other *ism*. It has also been called the lazy man's way. It is neither one. It is the necessary way if we are to keep our minds open to the valuable insights each system has to offer. Only thus can we be objective about the data we so carefully collect and pave the way for a more comprehensive understanding than has yet been reached.

Psychology Defined

Literally, the word *psychology* means the "science of the mind," but psychologists have never been satisfied with this definition because "mind" is a vague term that defies objective definition. So it is hardly surprising that definitions of psychology have varied considerably over the years according to the theoretical orientation of particular "schools."

Most contemporary psychologists would agree on a definition of psychology as the *science of the behavior of organisms*. By "behavior" they mean, first of all, activities or processes that can be observed objectively—both the isolated reactions of muscles, glands, and other parts of the organism and the organized, goal-directed patterns of reaction that characterize the organism as a whole. Psychologists also interpret "behavior" to include internal processes—thinking, emotional reactions, and the like—which one person cannot observe directly in another but which can be inferred from observation of external behavior.

A familiar example of such inference can be drawn from the game of football. The quarterback, having moved back to pass, is in danger of being thrown for a huge loss. He sees that an available receiver is so well covered that the chances of interception are great. He then throws a pass which lands many, many yards from his nearest teammate. The referee penalizes the team fifteen yards for intentional grounding a forward pass. In this situation only the quarterback knows his own inner mental processes—his conscious intent—yet it is evident that if a man is good enough to play quarterback on the varsity he ought to be able to pass within a few feet of his target. The referee infers from the quarterback's objective behavior a conscious intent to prevent a loss of yardage by sacrificing a down.

Although psychology has been concerned primarily with the behavior of human individuals and groups, it has also embraced the study of animal behavior. Animals have long held an important place in psychological laboratories, primarily because they can be subjected to strict experimental control. Experimental requirements often involve drastic interference with the normal living routine of subjects and some-

times even endanger their lives or health. As in much medical research, animals make fit subjects for such experiments, whereas human beings obviously do not.

Since the life span of most laboratory animals is short, and the litter large, it is possible to control genetic factors more easily than with people. Moreover, studying certain aspects of sexual behavior in man is generally frowned upon. Another advantage of studying animals is that animal behavior is simpler than human behavior and hence more amenable to investigation. Although great care is always necessary in interpreting human behavior in the light of findings from animal experiments, animal psychology has nevertheless shed much light upon our study of human beings. It has also led to the development of important experimental techniques for investigating the behavior of any living organism.

Where does the soul fit into this attempt on the part of modern scientific psychologists to understand how and why people behave and feel as they do? Psychology must limit itself to the study of observable phenomena. Thus it cannot concern itself with problems touching on the soul and its immortality. Psychology therefore makes no attempt either to confirm or deny the existence of an immortal soul. It merely leaves this most important field of inquiry to religion.

Psychology and Other Sciences

Behavior is determined by a complex of factors that are partly biological, partly anthropological, partly sociological, and partly psychological. Therefore, psychology is closely related to both the biological and the social sciences. This is recognized by the large majority of modern psychologists, whether they specialize in teaching, research, or the many applications of their science. As a former president of the American Psychological Association has said,

"Psychology . . . thrives on polygamy with her neighbors. Our marriage with the biological sciences has produced a cumulation of ever more powerful knowledge. So, too, our joint undertakings with anthropology and sociology." (Bruner, 1965, p. 1016)

But despite the fact that there is a great deal of necessary—and even desirable—overlapping among the various areas of science to which psychology is related, each retains its own particular emphasis.

Biology—the science of life—is the study of how all living things grow, repair their bodies, reproduce their kind, and carry on other life processes. The biological sciences most closely related to psychology are *physiology*, the study of the functioning of living organisms and their parts; *neurology*, the specialized scientific study of the brain and nervous system and the diseases thereof; *genetics*, the study of hereditary processes; and *embryology*, the study of the growth and development of organisms prior to birth.

Anthropology is the study of the physical evolution of mankind, the origins of racial groups, and the development of civilizations. Its examination of widely divergent cultures—particularly the so-called primitive ones—has provided psychology with much significant data for understanding the influence of cultural factors on human behavior patterns.

Sociology studies the laws underlying the development and functioning of groups of all kinds—social, political, economic, religious. Both informal groups and formal institutions are studied, with emphasis on the observable characteristics of the groups' structure and functioning rather than the individual motives or experience of the members. Sociology has helped psychology to understand not only group behavior but also the social influences upon the behavior of individuals.

Psychologists, sociologists, and anthropologists have found that they can contribute very significantly to each other's efforts. As a result there has developed a new discipline known as *behavioral science*, with emphasis on the problem of developing valid generalizations about human behavior in group situations. Important work in this area is being carried out in a wide variety of institutions and agencies, and an increasing number of books and articles show this broad orientation. The present text is dedicated to this interdisciplinary approach.¹

1. A discussion of the interplay of physiological and cultural factors in human behavior will be found in the article by Neal Miller in Reference Manual Section B.

THE THREE FACES OF PSYCHOLOGY

There are about 25,000 psychologists in the American Psychological Association, and the number is rapidly increasing. Nearly half of these teach and do research in colleges and universities. Others are employed in various areas of practical application of their science. A few devote all their time to research. ■▲ Let us look briefly at the areas with which these three types of psychologists are concerned.

The Teaching of Psychology

Teaching is the aspect of professional psychology that is most familiar to you as a college student. Psychology teachers, like the teachers of any other discipline, are well versed in their subject matter but often find greater reward in imparting the existing body of knowledge to students than in adding to that body of knowledge through research. Of course, many teachers of psychology, especially those in the universities, spend a portion of their time in research. Psychologists teaching in the community colleges as a rule devote less time to research; frequently, in fact, their institutions do not supply research facilities. One of the big problems in higher education today, not only for the psychologist but for the teacher of any subject matter, is how to divide his time between teaching and scholarship or research.

Certain institutions of higher education operate on what is called the "publish or perish" philosophy. In an institution where there is too much emphasis on research and scholarship, teaching may eventually come to play a secondary role. Other institutions recognize the importance of the "master teacher" and reward him through pay raises and promotions on a basis equal to that of the scholar or research scientist.

As institutions vary in their philosophies, so do individual psychologists. Some teachers of psychology are primarily science oriented; others are primarily people oriented. Those in the first group tend to place the highest value on knowledge for the sake of knowing, whereas the

people-oriented psychologist places more emphasis on the practical applications of his subject matter.

The author of this textbook advocates taking a middle road. He recognizes that knowledge can come only from painstaking research. But he also feels strongly that knowledge that is not put to work in the world, that is not used to help persons and nations solve their problems, is not of much interest to the average college student—or to anyone else.

This author believes that to be effective the instructor must study students before he attempts to teach them. He himself has done this many times in a systematic way—the first time in 1933 and most recently in 1966—and has found that students' basic interests have changed very little over the years. Students have been questioned before taking the course, after taking the course, and ten years after graduation. Always the answers have been the same.

Out of a list of 123 topics usually included in an elementary psychology course, the following ten have always been at the top in students' ratings of interest and value:

1. Understanding one's own personality problems.
2. How to improve one's own personality.
3. Human motivation.
4. Application of psychology to the training of children.
5. The technique of reasoning out everyday problems.
6. The problem of heredity vs. environment.
7. The development of character.
8. Psychological factors in crime and delinquency.
9. An understanding of mental disorders and insanity.
10. How to study effectively.

Analysis of the entire list of 123 topics shows that those rated highest are topics related to helping the individual get along in society as it is, while topics useful in making society better through application of scientific knowledge run a close second.

Using this information, this author has developed his objectives for the first course in terms of the interests of the students themselves. These objectives may be stated as follows:

1. To supply information which will help the student make an effective personal-social adjustment—to live better in the world as it is.

2. To help the student prepare for effective citizenship in his local community and nation and in the world—to make the world a better place in which to live.

3. To build an attitude of open-minded inquiry into all phases of human behavior and experience—to help the student seek new insights and apply the "scientific method" to human problems.

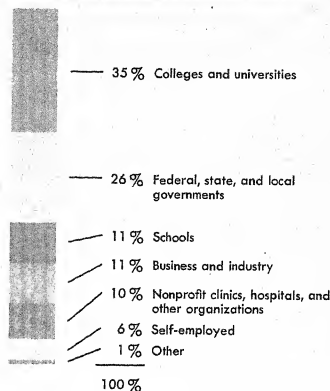
4. To acquaint the student with the basic vocabulary, methodologies, established facts, and sound principles of psychology.

5. To help the student understand the lack of and the need for an all-encompassing, non-Procrustean system of psychology.

The Application of Psychology

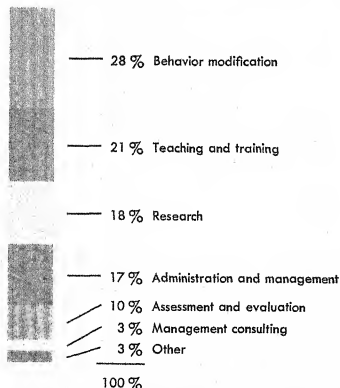
About half of the members of the American Psychological Association are engaged primarily

▲ WHO EMPLOYS PSYCHOLOGISTS?



Based on Ross and Lockman, 1963

■ WHAT DO PSYCHOLOGISTS DO?



Based on Ross and Lockman, 1963

in one or more of the numerous fields of applied psychology. Most of these nonacademic psychologists are engaged in some effort to help troubled people solve their problems of personal and social adjustment. Others work for school districts, in business and industry, and for the military or other governmental agencies. These applied psychologists, however, frequently engage in teaching and/or research pertinent to the needs of the organization which employs them. In this section we will take a look at the more important ways in which applied psychologists earn a living while serving society.

The clinical psychologist. Not all clinical psychologists work in clinics, nor are all the psychologists who do work in clinics clinical psychologists. However, a brief description of clinical work will serve to illustrate the duties of a large proportion of clinical psychologists.

Most psychological clinics deal with outpatients who come to them for help with individual problems. Often a clinic concentrates upon

a limited range of problems. A child guidance clinic may deal with marital problems but is unlikely to receive patients seeking aid for alcoholism or those desiring vocational rehabilitation. Clinics vary a great deal in types of service offered, length of treatment available, means of support, and composition and policy of the staff. However, in nearly all clinics certain specific functions are performed by the psychologists employed (Greening and Bugental, 1962).

One of the most important of these is *psychodiagnosis*, the total study of an individual to determine his present psychological functioning in relation to past events and to predict what may be expected from remedial measures. In this, as in other functions, the psychologist often works as a member of a team which includes a social worker, a psychiatrist or other physician, and sometimes members of other professions such as a nurse or an occupational therapist. Psychodiagnostic studies are necessary for determining whether a case can be appropriately handled by the particular clinic, for treatment planning, and for evaluation of clinic procedures. Common methods of obtaining information are interviews, standardized tests, and projective tests. The psychologist must be prepared to report on the results of these techniques at staff meetings, where discussions are held to determine for each patient the best possible treatment.

A wide range of psychotherapy may be carried on by psychologists in clinics, often in cooperation with a *psychiatrist*—a medical doctor who specializes in the diagnosis and treatment of mental disorders. Research evaluating this psychotherapy is another function of the psychologist in a clinic, as is research of other types. Teaching, in the form of supervision and training of other clinic workers, is also often among his duties. Often the psychologist finds himself called upon to take part in administrative functions such as policy making or employee selection which he did not contemplate when envisioning his work as a clinical psychologist. Since clinics are designed to serve the community, community relations and education may also become important duties.

In an institution to which patients are confined for varying lengths of time, the psychol-

ogist performs essentially the same functions as in a clinic. That is, he evaluates behavior, attempts to modify it, and carries on research. Testing and other assessment procedures in a mental hospital require a great deal of skill and alertness on the part of the psychologist because severely disturbed patients are likely not to be attentive or cooperative.

Attempts to modify behavior vary with the institution but most frequently include counseling, either individual or group psychotherapy, and vocational rehabilitation. As in the clinic, the psychologist often works as part of a mental-hygiene team. Recently there has been a trend toward "milieu therapy"—the attempt to make the institution as a whole a therapeutic community (Klebanoff, 1962). Ward psychologists are often responsible for planning the recreational and other activities which constitute this form of therapy.

Research has long been an important part of the work of institutional psychologists, and the trend is toward the creation of more positions in which full time is devoted to research. Most such research is practical rather than theoretical, devoted to developing improved methods of treatment. Social psychology research is coming to the fore as milieu therapy is used to a greater extent. Duties of the psychologist in an institution may also include training of future psychologists, since most hospitals offer internship programs, and consultation with hospital management regarding employee relationships with the large group of nonprofessional workers employed by the institution.

Psychologists may also work in institutions for physical disease, where their function is typically that of assessment. This includes basic psychodiagnostic testing and testing to determine the effects of physical disabilities on the patient's overall functioning. There is some opportunity to engage in psychotherapy, since many patients with severe physical illnesses also suffer emotional disturbances. In the case of those with permanent defects, psychotherapy may help the patient become motivated to lead as active and useful a life as possible instead of giving up and becoming dependent on society. Again, research is carried on, usually in collaboration with psychiatrists and other medical specialists.

Correctional institutions require essentially the same functions as do hospitals. In institutions for delinquent children, testing of personality and of intellectual ability is particularly important. Testing in prisons for adults is usually limited to vocational and educational tests designed to help determine the work assignment in prison, with a view to making it possible for the prisoner to obtain a job after being released. Psychotherapy is also practiced to a much greater extent with youthful offenders than with older ones. Counseling, small group or "buddy" systems, and milieu therapy are all important. In adult prisons, vocational rehabilitation is the main focus of attention, although some milieu therapy programs are employed. Research largely takes the form of follow-up studies to determine how well former prisoners have adjusted to community life after certain rehabilitation procedures have been followed in prison.

Whether working in a clinic, in an institution, or in private practice, the clinical psychologist, by the very nature of his duties, carries an especially heavy burden of responsibilities. Yet he may derive especially deep personal satisfactions from his work. As people turn to him for help with their deepest personal problems, he frequently finds that he himself is growing in many ways through his attempts to help others grow.

The school psychologist. A number of psychologists who enjoy working with young people but are not attracted by teaching or research find congenial employment as school psychologists. It has been estimated that at the very minimum, one such psychologist is needed for every 3,000 students (Newland, 1962).

Guidance counseling is one of the major functions performed by school psychologists. At first, this was chiefly in the form of vocational guidance, but its scope has been extended and today counseling for total adjustment is practiced in most schools. However, school psychologists do a great many other things besides counseling. One major job is individual testing of mental ability or personality adjustment. School psychologists also give group tests and interpret the results. They interview pupils, parents, teachers, and other school personnel,

compile data, and write up case histories. They also plan special programs for gifted or handicapped children, instruct teachers in group relations and in giving and interpreting group tests, help with curriculum development, conduct public relations programs with parent-teacher associations and other community groups, and often conduct remedial programs in reading and other educational skills. They also play a significant role in whatever research is done by the schools, though all too frequently such research proves to be quite limited and largely descriptive in nature.

The industrial psychologist. In some respects the work of the psychologist in industry resembles that of the school psychologist. Both are skilled at administering psychological tests and at counseling individuals with regard to their adjustment. The industrial psychologist plays an important role in the selection and placement of employees in large organizations (Katzell, 1962). After systematic study of a particular job has provided a suitable job description and a criterion of job success has been decided upon, he selects psychological tests which he believes will be most likely to predict success on that job. These tests are administered to a sample of applicants (or sometimes present employees), and evaluations of the actual job



■ Psychological tests for children are usually interesting and fun for them. In testing a child individually, the psychologist can find out a great deal that does not show up in the results of group tests.

performance of these individuals are later obtained. If those who made high scores on the tests are for the most part those who do best on the job, the psychologist knows the tests are valid for that particular job. Usually only the most effective of these "tested" tests are retained for use in selecting employees. By further analysis of the data, the psychologist can determine minimum scores which applicants must exceed in order to be hired. Such a program not only enables the company to obtain efficient employees at less cost but saves a great deal of unhappiness for employees who might otherwise be placed in jobs for which they were unsuited and who would fail, perhaps after months of trying. Another major advantage of the use of objectively scored tests in hiring is the guarantee they give that members of minority groups will be selected or rejected without prejudice.

It is interesting to note that although 85 per cent of the larger employing companies and all branches of the military service make use of psychological tests, 37 per cent of a cross-section of Americans over the age of eighteen are opposed to such a practice (Brinn, 1965). Here is a personal-social problem that will have to be analyzed and solved through calm consideration of all of the facts.

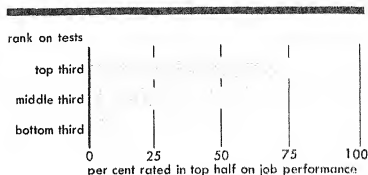
In addition to the testing and selection of new employees, the industrial psychologist conducts training and development programs. He may also engage in counseling designed to better the employee's adjustment to his job.

Another aspect of his work is *human engineering*—adjusting the job to the employee. He studies the methods of work, the motions involved, the physical environment, and the design of the equipment used, with a view to the most efficient performance of the job with the least strain to the employee.

Social aspects of the job are also studied. In an effort to determine how employees feel about their work and thus establish two-way communication between workers and management, the psychologist may conduct an employee opinion poll. In such a survey employees have an opportunity to indicate in anonymous questionnaires their opinions about physical environment, supervision, hours, and other aspects of their jobs. Management, in turn, at-

TEST SCORES AND JOB PERFORMANCE

In a study of oil company technicians, supervisors' ratings of these workers' performances were compared with their results on a test especially developed for selecting oil technicians. When the group was divided into thirds on the basis of the test results, it was found that 75 per cent of the top third on test scores were in the top half on rated job performance. By contrast, only about 12 per cent of those in the bottom third on the test were in the top half on rated performance.



Based on Altman, 1954

tempts to improve conditions, where possible, on the basis of survey findings.

Surveys may also be conducted to further the company's relations with consumers or to better its sales. Product testing, media research, and various other forms of consumer research or motivational research are carried on under the direction of the industrial psychologist.

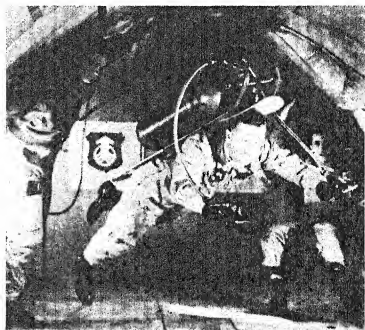
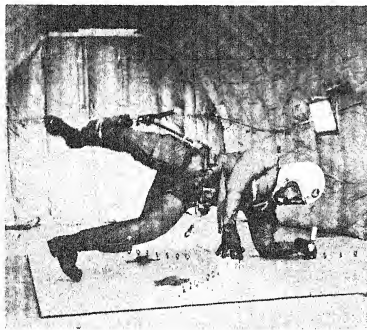
Although industrial psychology is still a relatively small field, it is expanding rapidly. Many more business executives are coming to accept the value of the psychologist in industry. Thus in one recent study 66 per cent of the executives polled stated that, given the authority, they would hire an industrial psychologist (Feinberg and Lefkowitz, 1962). This represents a considerable percentage gain over previous studies in which only 53 per cent of the replies were favorable in 1946 (Stagner, 1946) and 54 per cent in 1956 (Tiffin and Prevratil, 1956).

The psychologist in government service. A number of industrial psychologists find employment in government agencies rather than private industry. In fact, in 1964 at least 1600 psychologists were employed full time by the

federal government and nearly 900 were serving as part-time or intermittent consultants (Brayfield, 1965). Of course many more are employed by state and local agencies of various kinds. The work of those employed in clinics or institutions, many of which are supported by government agencies, has been described above. Another major field for the government psychologist is personnel psychology—selection and classification of personnel and analysis of job structure—which is in special demand in the armed services. Test development is the chief function of the personnel psychologist in the Civil Service, and vocational counseling is an important activity in the United States Employment Service. Human engineering is particularly important to the military and may involve such varied projects as the measurement of night-seeing ability or the dynamic simulation of space flight. Clinical psychology programs are also found in all branches of the armed forces, as are training and indoctrination programs which require the services of psychologists.

The psychologist in private practice. The independent psychologist who prefers to be his own boss may choose to establish himself in private practice as a psychotherapist, a consultant to industry, a psychometrist (specialist in psychological measurement), or perhaps a research specialist. Usually he does not do this, however, until he has had considerable experience with some organization or institution so that he has some contacts, some reputation in the field, and above all a bank account to fall back upon while getting started. Aggressive advertising is against the ethical standards of the profession of psychology, so that caution must be exercised in attempting to obtain clients.

Once he is established, the private clinician's work is quite similar to that of other clinical psychologists. He conducts much the same diagnostic and remedial work as the psychologist in a clinic, but without team activity, although he may work to some extent with the physician or other professional person who referred a patient to him. If his clients are mostly adults, he may have to keep inconvenient hours, before



In tests conducted under a simulated condition of weightlessness, it was soon discovered that a free-floating man cannot even turn a screwdriver to tighten a screw: instead, his body does the turning. A man tethered at both toes and waist (*left*), however, has the necessary leverage and can apply high torque effectively. For moving from one place to another under conditions of weightlessness he must learn to use a propulsion unit (*right*). This man is moving forward propelled by jet nozzles which he activates and aims by means of fingertip controls.

nine o'clock in the morning and after five o'clock in the afternoon, in order to enable working individuals to see him conveniently. Thus his independence has its price. He also has the full responsibility for public relations. About one third of the psychologists in the nation with clinical training have elected to pursue the adventurous course of private practice at least part time (Harrower, 1962).

There is a fairly substantial group of psychologists in private practice who specialize in helping not individuals but organizations. Although large corporations can employ one or more full-time psychologists, smaller companies do not have enough need to justify such a procedure. But when they do need services of this type, they need just as high a quality of service as do the larger organizations. In response to this situation, a number of psychologists in private practice limit their activity to working with smaller industrial and commercial firms.

Research in Psychology

Psychology, like other sciences, is a child of curiosity, born of man's age-old desire to *describe, understand, predict, and control* conditions and situations both in the world about him and within himself. The research psychologist devotes himself to increasing man's knowledge of the principles of behavior. In doing this he makes use of a variety of procedures, many of which he shares with research workers in the other sciences.

Description. All sciences have as a goal the accurate description of some aspect of the natural universe. The psychologist, of course, has chosen the behavior of man and other animals as his sector of the universe. Some sciences, such as anatomy, go very little beyond objective description, while others, such as theoretical physics, go far beyond this. As you get into the more detailed study of psychology, you will come to appreciate how extremely difficult objective description of behavior is. Not only are most living organisms highly complex and intricate systems, but the observer often has difficulty in maintaining an objective, unbiased attitude—particularly with regard to the de-

scription of human behavior. Yet one of the distinguishing features of any scientist is that he does not let his expectations or prejudices color his observations.

The psychologist thoroughly appreciates the validity of the old adage, "What you look for you will find," and he sometimes goes to elaborate lengths to keep himself in the dark as to a factor which might prejudice his observations. For example, a psychologist studying the effects of a certain drug on human behavior would conduct a *double-blind* test. That is, he would arrange that the drug be administered by someone else, so that he would not know until he had completed his evaluation which subjects had received it and which had not.

In new areas of research particularly it is often difficult for the investigator to maintain his objectivity. The closer he comes to a discovery that will be a real breakthrough into new areas of knowledge, the harder it becomes for him not to let what he wishes to see stand in the way of unbiased interpretation of results—no matter how good his intentions. When we read of "astounding new discoveries" in psychology, or in any science, it is well to be cautious about accepting them until time has proved their worth.¹

Only rarely does an apparent breakthrough prove to be a hoax. It can happen, though, as in the case of the "proof" of the inheritance of acquired characteristics presented early in this century. Here a careless scientist reported the work of a technician so anxious to please the great scientist that he had injected India ink under the skin of salamanders to make the experiments come out the way the scientist wanted them to. More often, the "breakthrough" that loses its momentum and is quietly buried is simply based on experimental error, which can happen to the best and most careful scientists.

Understanding. The scientist's second goal is to understand—to be able to explain the underlying order in the confusions and complexities of nature, of which man himself is a part. But with the world full of so many things, the hu-

1. A further examination of ways in which experimenters may unknowingly influence their results will be found in the article by Robert Rosenthal in Reference Manual Section B.

man mind cannot possibly deal with them all individually. In psychology, as in other sciences, understanding requires that facts be grouped or classified into meaningful categories on the basis of stated aspects of similarity. Two basic kinds of classification are employed: *qualitative* and *quantitative*. Actually, the line between the two is not entirely distinct.

Qualitative classification. In qualitative classification, items are grouped in categories on the basis of some particular quality or characteristic they have in common. People, for example, can be classed as males or females; as blondes, brunettes, or redheads; as Republicans or Democrats; as married, single, widowed, or divorced. For more precise scientific study, members of a class may often be divided into various subgroups. For instance, if people are classed as blind or sighted, those with sight can be further classed as normal or color blind.

Although the persons put into a particular class may resemble or differ from each other in a number of ways, they are all alike with regard to the characteristic by which they were grouped. Equally important, each member of the class is different from members of all other classes in respect to this particular characteristic, although the same individuals may be either alike or different in other characteristics.

The important thing about qualitative classification is that the classes or categories are not related to each other in a mathematical (quantitative) manner. Qualitative classification is primarily a process of sorting items into groups and giving the groups appropriate labels.

In addition to its value as an instrument of scientific inquiry, qualitative classification in psychology frequently produces results of considerable practical value. For instance, research conducted with personnel in the insurance business has shown that married men generally make more successful insurance salesmen than single men. Thus, by classifying all job applicants into the qualitative categories of "married" or "single," we can predict whether a particular applicant is *likely* to prove successful or unsuccessful should he be hired and trained as an insurance salesman.

Quantitative classification. In a quantitative classification, categories are determined on the basis of different degrees of some measurable

characteristic. All the persons or objects in a group can be ranked on the degree to which they exhibit that characteristic. The categories are usually labeled in terms of the mathematical relationships between them. For example, students might be classified according to the number of credits for which they were enrolled in school—for 10 units, 12 units, or 15 units, perhaps. These numbers could be used to designate the relationship between the groups of students in terms of their academic workloads. By knowing to which category a student belonged, we could tell whether he was taking more or fewer units of study than a student in another category, and we could express mathematically the difference in their loads.

The prerequisite to quantitative classification is measurement. A characteristic which can be measured and expressed in numerical terms is called a *dimension*. Some typical dimensions used by psychologists in classifying human beings are age, intelligence, emotional stability, auditory acuity, and reaction time.

Numerical values such as grade-point average and reading speed are end products of measurement and are called *scores*. Quantitative categories are usually labeled in terms of such scores. Even when we use descriptive terms such as *tall* or *short* and *young* or *old*, we are using coarse quantitative labels for the dimensions of *height* and *age*.

The psychologist's ultimate aim is to make all classifications quantitative, though in many areas he is still far short of this goal. He prefers to work with quantitative categories because he can make his predictions more directly and precisely—and check on their accuracy better—when the available items of information (sometimes called *predictors*) and the behavior he is trying to predict both can be expressed in numerical terms.

In a recent study, aptitude test scores were the predictors and the behavior to be predicted was success in a high-school algebra course. "Success" was defined as getting a higher-than-average mark on the final examination. Of those students who were in the upper half of their group on a series of aptitude tests given before the course began, 77 per cent were above average on the final examination (Guilford, Hoepfner, and Petersen, 1965).

Quantitative statements regarding predictive accuracy such as the above can be made more simply by using the correlation coefficient, a statistic to be discussed both in Chapter 5 and in the statistics manual at the end of this book.

Principles and theories. After many observations have been made and much evidence has been painstakingly gathered, it is possible to begin making meaningful generalizations about consistent relationships. One of the basic operations of psychology is organizing *facts* about human behavior into general, useful *principles*.

To achieve scientific understanding, however, the scientist must go one step further and organize his principles into a logical framework which demonstrates in an orderly, consistent manner how the various observed facts and derived principles are related. Such a systematic statement of relationships is called a *theory*. The value of a theory is measured in terms of (1) its ability to explain the known facts and to show relationships among previously unconnected concepts and observations and (2) its usefulness in suggesting specific hypotheses that can be tested in further research. Although facts do not change with time, the observation of new data often makes it necessary that theories be modified or discarded. In such cases the scientist tries to formulate a new theory which will embrace all the known relevant facts and explain them as fully as possible.

When understanding is sought scientifically as an end in itself, we speak of *pure science*—as distinguished from *applied science*, which seeks and uses scientific knowledge for some practical purpose. In the modern sciences, however, and particularly in the social sciences, this distinction is regarded as artificial and is largely disappearing. Pure and applied science are alike in their methods of study.

Prediction. In addition to his desire to understand nature, man throughout history has sought to know the future—to predict and prepare for events in advance of their happening. In ancient times oracles and soothsayers held positions of great honor, for they were credited with a supernatural ability to reveal the future by reading signs from the gods. Today man relies largely on science for his predictions of the future.

To make a scientific prediction we must first identify a consistent relationship between persons, events, situations, and conditions. For example, each year thousands of hopeful high-school students take the well-known "College Board" examinations. A comparison of students' scores on these tests with their later success in college has indicated, over a period of time, that those who make high scores are more likely to succeed in college than those who make low scores. Thus, from the score an individual makes on these tests, we can classify him as either a probable success or a probable failure in college. In other words, we can *predict* whether or not he is likely to succeed in his college career.

In a recently reported study on the success of students who entered college in 1956 after being named National Merit Scholars, it was



■ This Air Force cadet is taking a finger dexterity test, one of a series of psychological tests devised to determine the individual's service classification. By assigning each man to the job for which he is best suited, the Air Force achieves maximum operating efficiency and morale.

found that 96 per cent had graduated from college by June 1964 (Stalnaker, 1965). The comparable figure for all students entering college is estimated to be 60 per cent. Obviously, a high score on the National Merit Scholarship Qualifying Test is predictive of success in college.

Control. Man is not content to describe, understand, and predict. There are many occasions when he wants to influence and change what happens. This wish creates a fourth major objective for scientists—that of control. In the field of psychology during the past few decades, the ability to plan and direct many aspects of human behavior has increased considerably. In the area of vocational guidance, for example, psychologists have been able to determine how success and satisfaction in a particular occupation are related to specific patterns of abilities, interests, and other measurable human characteristics. Utilizing this knowledge, the vocational counselor is able, through personal interview data and psychological test scores, to offer advice as to the vocational fields that are most likely to offer success and happiness for a particular client. Such control is used widely by our armed forces in classifying men for special training. ■

In his efforts to ensure job satisfaction for all employees, the industrial psychologist goes even further. Knowledge gained from scientific research is used by the management of large factories and businesses to maintain pleasant working conditions and good employee morale. Such things as company news bulletins, periodic coffee breaks, employee suggestion boxes, and after-work social functions are examples of modern personnel practices which have been shown not only to improve the employee's morale but also to obtain more efficient performance on the job.

Control based on the accurate *prediction* of behavior, as in the examples above, is only one possible type. Adequate control often involves the *modification* of behavior. In the field of vocational rehabilitation, for instance, persons who have physical handicaps resulting from injury or disease are taught new skills that will enable them to work and return to normal living. Youth centers aid in the prevention of juvenile delinquency by teaching new social skills and

● The Rudder Control Test shown here presents a problem very similar to taxiing a plane on the ground. By operating a rudder bar control, the examinee must balance the cockpit and keep the nose of the apparatus pointing at the target. Testing apparatus such as this enables instructors to be fairly certain of a trainee's ability to learn to handle an airplane when given an opportunity to do so.



attitudes. The United States armed services have developed training procedures in which they attempt to control the future behavior of their men by presenting them with problems that simulate conditions they will meet later. ● Another example of control through modification is provided by psychotherapy, which often enables the troubled person to resolve his problems through greater understanding of himself.

The ability to influence and manipulate behavior offers many exciting possibilities for bettering social and working relationships, making education more effective, improving the techniques of psychotherapy, and so on (Rogers and Skinner, 1956). But control is also potentially dangerous. Whenever it is established that if certain conditions exist, certain behavior can be predicted, it becomes possible to bring about that behavior by creating those conditions (Rogers, 1956). The frightening success of brainwashing techniques has highlighted dramatically not only the potential effectiveness of psychological control but also the practical

and ethical problems it poses. Robert Oppenheimer, the well-known physicist, said in a speech to the American Psychological Association:

"... The psychologist can hardly do anything without realizing that for him the acquisition of knowledge opens up the most terrifying prospects of controlling what people do and how they think and how they behave and how they feel. This is true for all of you who are engaged in practice, and as the corpus of psychology gains in

certitude and subtlety and skill, I can see that the physicist's pleas that what he discovers be used with humanity and be used wisely will seem rather trivial compared to those pleas which you will have to make and for which you will have to be responsible." (Oppenheimer, 1956, p. 128)

Perhaps the greatest challenge psychology will have to face in the years ahead will be seeing to it that the scientific advances it makes are used for the benefit of mankind.

OBSERVATION AND DESCRIPTION IN PSYCHOLOGY

The complexity of the subject matter with which modern psychology deals is obvious. The behavior of any one person is variable from day to day, and no two persons are exactly alike. Human behavior is by its very nature far less subject to accurate observation and description than are the relationships with which the physicist or chemist deals. As a relatively new science, furthermore, psychology has neither the rich background of collected knowledge that is available to the older sciences nor the same wealth of tested research methods. Nevertheless, psychologists have tried to operate according to the same principles and within the same restrictions as the other sciences.

Kinds of Observation

The most basic technique in psychology, as in any other science, is observation. Because the subject matter of psychology traditionally includes both inner experience (feelings, perceptions, wishes) and overt behavior (actions, speech, gestures), two kinds of observation have been employed in psychological research—*introspection* and *objective observation*.

Introspection. The method of introspection has already been mentioned as the technique

employed by Wundt and his followers in their study of conscious states and processes. The subject, by observing his own thinking and feeling, is able to furnish a report on conscious activities that might otherwise be overlooked. Certain problems in psychology can be studied only by introspection.

A trained introspectionist of the Wundtian era would describe an object in terms of its impact on his senses—in terms of such attributes as taste, color, smell, and sound. Rather than report the conscious experience of "seeing a piece of chalk," he would report perceiving a cylindrical white object which felt hard and lacked flavor and odor. Introspection of this type was an attempt to describe all sensations in terms of a set of basic attributes, much as a chemist describes compounds in terms of their component elements.

With a little practice, any normal adult can learn to perform simple introspections, but introspection cannot be used with animals, young children, the feeble-minded, certain mentally ill persons, or anyone not trained in its technique. Furthermore, the person who is color blind or tone deaf or "taste blind" cannot discover this fact about himself through introspection alone. Another important difficulty is that much of man's internal behavior is wholly or partially unconscious and hence cannot be observed by

this method. But the most serious charge against the introspective method is that its findings cannot be checked by another observer: an observer can do no more than analyze the subject's verbal report, which is not the same thing as analyzing the consciousness itself. Considering these various limitations, it becomes obvious that a psychology based entirely on introspective information would be narrow indeed.

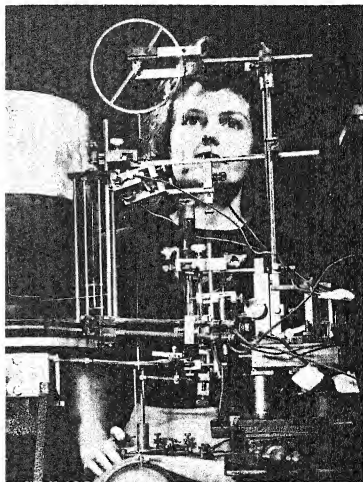
Objective observation. The second major technique psychologists use to obtain facts about behavior is objective observation. Here the experimenter notes what his subject *does*—not what he feels or thinks. The environmental conditions under which a response occurs, as well as the response itself, are systematically described in detail. Thus the situation can be duplicated or recognized by another worker, or by the same worker, at a later date. Complicated apparatus is frequently used to obtain graphic records of the subject's behavior. That such records can be analyzed by several psychologists adds greatly to the accuracy and value of this method.

Objective observation is concerned mainly with what goes on in the external world, not with what happens within the subject, but it does not stop there. The psychologists of this age have many instruments for observing what goes on inside the organism. Among these are devices for studying the electrical currents of the brain and the changes in conductivity of the skin during emotion. Although objective observation, even with good recording instruments, does not give a description of all that goes on in any subject, it does permit us to study the wide variety of subjects who, for reasons noted above, cannot be studied by the method of introspection.

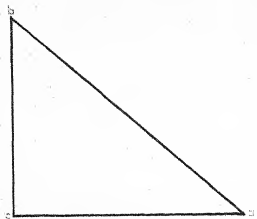
Introspection and objective observation combined. Introspection is aimed at describing inner experience and objective observation at describing aspects of behavior observable to others. Thus they supplement each other, and often they are used in combination. ▲ An example is the following experiment, which was conducted to investigate the ability of blind people to orient themselves in space.

To determine the ability of the blind to orient themselves, two groups of subjects were used—one group totally blind and the other group sighted. Both groups were blindfolded and given two orientation tests. On a large concrete area outdoors, various-sized triangles similar to the diagram on the following page were drawn in chalk.

In the first test each subject was started at point A and led by the experimenter along the path A-B-C. He was then instructed to return in a straight line directly from point C to point A. In the second test, each subject was led from point A to point C and then instructed to return to point A along the path C-B-A. On each test the subject's score was recorded in terms of amount of error—that is, the number of feet he stopped away from the starting point.



▲ Introspection and objective observation are combined in this experimental study of adaptation to tactile pressure. When the subject no longer feels the pressure of the weight on her knee (introspection), she presses the telegraph key. By means of the complex apparatus, the subject's overt responses are recorded graphically in the drum at the left.



The results of these objective observations are summarized in the following table, which shows the average number of feet by which each group missed the starting point on each test.

	Blind	Sighted
Test 1	6.3	4.7
Test 2	6.8	5.0

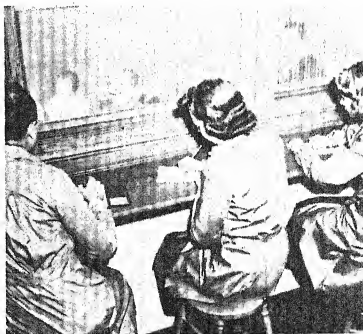
Although these results indicated that the sighted subjects were more accurate in their space orientation than the blind, the objective evidence gave no clue as to why this should be. To help solve this problem, the subjects were asked for introspective reports of their experiences during the experiment. Although many of the subjects could not explain their mental processes during the tests, some of the subjects in both groups indicated that they had relied on estimation of the time it would take to return to the starting point. In addition, some of the sighted reported that they had pictured in their minds what the unseen path would look like. These reports led the experimenter to conclude that the blind rely primarily on time for distance estimation whereas the sighted, when blindfolded, use both time and visual imagery (Worchel, 1951).

As mentioned before, the earliest psychological research used introspection exclusively, attempting to analyze and describe sensations, images, and other "elements of thinking." Later psychologists, in the interests of scientific rigor, went to the opposite extreme and studied only external behavior, because it could be observed objectively and subjected to measurement of some sort. It is generally realized now that the two methods used together give a more nearly complete description than either one does alone.

Observation and the Uncertainty Principle

It has become apparent to physicists dealing with subatomic particles that an object or process may be altered in the process of being measured. In psychology, too, an event may be changed by the presence of an observer (Fine, 1960). For example, a mentally troubled individual, in talking with a psychologist, may hold back certain fantasies and unconsciously alter the facts to paint a more favorable picture of himself. When a teacher and class are being observed, their awareness of the observer may change their responses and interactions so that what the observer sees is not typical at all. This difficulty can sometimes be overcome by the use of a one-way screen through which the subjects can be watched without their realizing it.

The results of an experiment can be only as accurate as the particular measuring device used. Although psychologists are constantly developing more refined measuring instruments, they must not lose sight of the limitations of psychological measurement. Caution is always needed in accepting and interpreting results.



◆ One difficulty in observing people's behavior is that the observer's presence tends to destroy the subjects' spontaneity. With a one-way screen like this, several observers at a time can take notes and even discuss what is going on without disturbing the subjects.

Operational Definitions

Suppose a psychologist wishes to observe the effects of hunger on behavior. Hunger may be abstractly defined as "need for food," but for scientific purposes this definition is inadequate since a "need" cannot be observed directly. The psychologist must devise a definition in terms of behavior that can be observed and, to some degree, measured. Thus, in defining hunger he might say: "The subject displays hunger if, after a specified period of food deprivation, he eats when food is presented." The eating of food is an *operation*—a form of behavior that can be objectively observed by the experimenter. This is called an *operational definition*.

The psychologist uses similar operational definitions in studying such abstract concepts as intelligence, learning, memory, motivation, and emotion. Fatigue, for example, might be defined operationally as the reduction in the amount of work a person performs per unit of time following a period of time spent in performing the same work.

An operational definition of a concept like *patriotism* would be more difficult to state, since a very complex pattern of overt behavior and inner feelings is involved here. In designing an experiment involving patriotism, one psychologist might operationally define patriotism in terms of such overt behavior as flag saluting and anthem singing. A second psychologist might insist that these are not true manifestations of patriotism and thus discount any experimental results based on such a definition. He could not do so, nor could he duplicate the experiment, had the original experimenter simply stated that he had used "patriotic" subjects, giving no operational definition of the term *patriotic*. Because they are stated in terms of observable events or operations, operational definitions greatly increase the precision with which the psychologist can make and interpret his observations.

Logical Constructs

In the interpretation of experimental results, the psychologist frequently finds it helpful to imagine the existence of an unobservable quali-

ty or substance or process through which the outward, observable behavior is shaped. A concept of this kind is called a *hypothetical construct* or *logical construct*, because it is invented or "constructed" by the experimenter as a logical explanation for what takes place in his experiment. The following study illustrates the use of such constructs.

Hungry rats were fed mash through the bars of a grid which could be charged with electricity. Ten seconds after the rats began to eat, a mild current was turned on by the experimenter. The animals in one group could turn off the current by leaping off the grid; those in the other group could not. They were shocked for exactly the same length of time as the others, but their own efforts did not have anything to do with cutting off the shock.

It was found that the animals who could control the current ate much oftener and more quickly than the others. The experimenters postulated that in the second group there was a psychological factor, which they named "sense of helplessness," that caused the animals to eat less (Mowrer and Viek, 1948).

In this experiment the "sense of helplessness" was a logical construct. Such a construct is sometimes called an *intervening variable*, because it is assumed to intervene between the variables controlled by the experimenter and the changes which appear to be taking place as a result of the experimental manipulations. The use of the term *intervening variable* is ordinarily reserved, however, for logical constructs that have been used in enough experiments to have developed a constant form.

Psychologists use many logical constructs in explaining such events as improvement following practice and failure later on to recall what has been learned. A person who has memorized a poem, for example, usually finds that after a month he can no longer repeat it all and that after a year he can remember even less of it, or none at all. In studying this process of forgetting, some psychologists have come to believe that when learning takes place, certain connections are formed in the nervous system and brain which are gradually destroyed unless maintained through practice. The concept of these connections is a logical construct, because the connections cannot be observed directly. By using this construct psychologists have been

able to set up numerous experiments on the learning process and to discover many valuable principles which aid in learning.

Constructs of this kind can be of considerable value during the early stages of experimentation in a given field, but they must be clarified and made more specific if they are to continue being helpful. Otherwise they may be-

come empty abstractions erroneously leading the investigator to think he understands a process because he has given it a name. Such concepts as "intelligence," "drive," "habit," and "emotion" are examples of logical constructs which have been defined over a period of time and which have proven very useful to psychologists.

METHODS OF STUDY

In any science, several different methods of study must sometimes be applied to a problem before all the pieces fit together properly. Each method contributes in its own way to the final solution. In planning a study, the scientist attempts to select the method or methods most appropriate to the particular problem under consideration. The five chief methods that psychologists use are the *field-study method*, the *life-history methods*, the *survey method*, the *experimental method*, and *statistical control and analysis*. These methods are not mutually exclusive, and a variety of observational and measurement techniques are used in each.

Field-Study Method

The field-study method is the oldest research technique used in any science. It is not a substitute for the experimental method but is often applicable where experimentation is impossible. The field-study method might be described as making direct observations of nature. The investigator simply goes into the field with a definite question (or set of questions) and makes observations, without trying to hold constant or even to know all the conditions under which his subjects are operating. Often the observer does not even need the direct cooperation of his subjects—in fact, some field studies are most successful when the subjects are not aware of being observed. In other instances the

investigator finds it helpful to join in the day-to-day life of his subjects for a time in order to gain a clearer understanding of their ways of living. The pictures on page 403 are from a field study investigating social development in a primitive culture.

Life-History Methods

Life-history methods of psychological research involve making intensive studies of individuals over a considerable period of time, usually in the attempt to trace the *development* of a particular form of behavior being investigated. In other words, the psychologist studies the conditions in people's lives which have led to their becoming whatever they are, be they criminals, physicians, spinsters, or political agitators. By studying the antecedents of a specific form of behavior, he hopes to find its causes. The three basic life-history methods are the *daybook method*, the *clinical method*, and the *biographical method*.

The *daybook method* is most often used in child study. The child's development is carefully observed and recorded day by day. • A daybook record might contain descriptions of when a baby first sits, stands, walks, and begins to talk. Accumulated records of this kind give us standards by which we are able to judge the normality of the development of individual children.

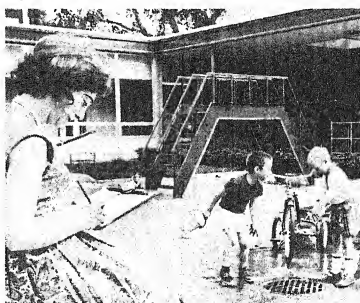
The following excerpt is a good example of the daybook method. It is from the report of an intensive study of the way children develop devices for coping with newness, accidents, and other challenges.

"Since the photographer was waiting in the yard to take additional pictures, AM now suggested that she and Ronnie go back to the yard where the others were engaged in various activities. To this he responded, 'OK, I'm gonna build a house first. I want to build little houses.' He had picked up several small geometrical shapes in various colors and laid them on one of the large cardboard blocks which resembled bricks. He set this up to look like a roof on the top of the large blocks. He stayed with this activity only very briefly however and then moved over to examine an additional box of toys. After thus expressing his autonomy he acted on AM's suggestion, saying, 'I'll beat you out' [to the yard where the others were playing]." (Murphy, 1962, p. 109)

The *clinical method* represents an elaboration and extension of the daybook method. Here the past life history and present life situation of a person are explored on the basis of any information available, usually in an effort to discover the cause of—and solution to—some emotional or social adjustment problem. The most effective clinical study usually requires at least three professional functions. A physician examines the individual for signs of physical illness; a social worker examines the home conditions which surround and have surrounded the patient; and a psychometrician administers and scores various tests of aptitude and personality. When a full record has been obtained of the important past and present influences in the patient's life, this information is put together and discussed at a staff meeting and recommendations are made. In some cases extensive therapy is undertaken; in others special training of some kind or a change in the home situation may be called for. A good psychological clinic provides for a follow-up to see whether its recommendations have been carried out and whether progress has been made.

The clinical method has two important functions. First, it *compiles information* concerning the emotional and personality adjustments of human beings and is thus an additional means

● Observing children while they are at play is one of the best ways of finding out about their abilities, motivations, and fears. Careful records of repeated observations of the same individuals or groups made over an extended period often bring to light behavior patterns that do not reveal themselves under casual observation.



of observing and interpreting facts. Second, this method involves attempts to *modify behavior* in the interests of greater personal and social welfare.

The *biographical method* is simply an attempt to obtain psychological understanding from an analysis of the records of men's lives as set down by themselves or others. An example of the use of the literary biography for psychological research is found in a study by the famous psychologist and educator Edward L. Thorndike, who made personality analyses of ninety-one famous men on the basis of information contained in their biographies (Thorndike, 1950). Using evidence drawn from the writings, speeches, and actions of these men, Thorndike undertook to rate each man in terms of forty-eight different personal characteristics such as intelligence, sensitiveness, sociability, agreeableness, liking for beauty, liking for exercise, and so on.

The results of such biographical studies can be useful in giving insight into the characteristics which underlie the achievement of greatness in various professional fields. There are certain important limitations, however, to the

scientific value of this method. In the first place, the biographer's motivation is always a matter of question. The writer may strive for a true record, but if his interest is great enough to motivate him to write, he is likely to be biased either for or against his subject. In the second place, biographical accounts are not always sufficiently complete or accurate, for most biographers are not psychologists and may overlook seemingly insignificant incidents which actually were important in determining the course of the person's actions and achievements. Lewis M. Terman, a psychologist who devoted much of his life to a study of mental development, complained of "the utter inability of a majority of otherwise competent biographical writers to appraise and interpret the facts which they themselves have recorded with reference to the early mental development of their subjects." (1926, p. v)

Survey Method

When it is not feasible or desirable to spend a long period of time in the field or to obtain data about all the individuals in a group, much valuable information may be obtained by conducting a *survey*. In this method the investigator, by using written questionnaires or oral interviews, obtains data from a selected group. It is important that he choose his group carefully so that it will constitute a *representative sample* of the larger group, or *universe*, in which he is interested. A representative sample is one drawn in such a way that every person in the universe from which it is drawn has an equal chance of being selected. If the sample is not representative, the data collected will be of little value.

One of the best-known types of survey is the *opinion poll*. Political opinion polls are perhaps the most widely used kind, particularly in election years, but the opinion poll has many other uses. It is being used increasingly in industry as a means of determining consumer preferences and of improving employee-management relations. Conducting and interpreting surveys and opinion polls will be discussed in greater detail in Chapter 16.

Experimental Method

The most highly developed, formalized, and accurate of all scientific methods is the experimental method. This method provides a procedure for testing the validity of tentative hypotheses and predictions that have been formulated on the basis of previously observed facts. It is the one preferred by most psychologists, and the one that has given us most of our basic facts.

Before making any actual observations, the experimenter carefully defines and analyzes the problem under consideration to ensure the greatest possible accuracy and clarity of results. A formal statement called the *experimental design* defines the experimental problem, states the conditions under which the observations are to be made, describes the instruments and apparatus to be used in making accurate observations, and outlines the procedures to be followed in interpreting the results. The preparation of an experimental design (and its inclusion in the final published report) has an advantage over less formal methods in that it allows the same experimenter, or other experimenters, to repeat the investigation under the same conditions in order to see if the same results are obtained. Such replication is essential, for only as early observations are confirmed in later studies can they be finally accepted with confidence. Indeed, replicability is the mark that distinguishes sound work in any science.

Hypotheses in experimentation. The experimental problem may be stated in two main ways. The first and less sophisticated way has been called the "I-wonder-what-would-happen" approach (Underwood, 1949). For example, what is the effect of vitamin X on ability to memorize meaningful prose passages? To find this out, procedures for measuring the speed of learning would be devised. One group of subjects would be given daily doses of the vitamin for a month and another group of similar individuals would not. Both groups would attempt to memorize the same passage and, after all the subjects had been tested, the average scores of the two groups would be compared. This comparison would tell whether the vitamin helps, hinders, or has no effect on learning.

A more sophisticated approach would involve the formulation and testing of a specific *hypothesis*—the “I’ll-bet-this-would-happen” approach. If, for example, studies with rats and monkeys had shown that the administration of vitamin X increases the ability of these animals to learn simple nonverbal tasks, the psychologist might reason something like this: Rats and monkeys are animals that can learn. Learning in human beings has been found to be similar in some respects to learning in lower animals. If vitamin X facilitates learning in lower animals, it should facilitate learning in human beings. On the basis of this accumulated knowledge and analysis, the psychologist would probably state his problem in the form of a hypothesis as follows: Vitamin X increases the ability of adult human subjects to memorize meaningful prose. He would then carry out experimental procedures essentially the same as those described above in an attempt to verify this hypothesis.

The testing of a hypothesis is the more sophisticated and the more usual of the two approaches. In most instances the hypothesis is logically deduced from the results of prior investigations; only rarely is the investigator so little aware of what is to be expected that he simply poses a question.

Variables in experimentation. As we have seen, the crux of the experimental method is in the procedures used for testing hypotheses. The factors with which the experimenter is concerned in so doing are called *variables*. The variables involved in a particular experiment may be classified as *independent*, *dependent*, and *relevant*.

The independent variable is the factor whose effects are being studied—treatment with vitamin X in the previous example. The experimenter changes this variable (giving the vitamin to some subjects but not to others or giving more to some than to others) in order to see what the effects of these changes will be. The dependent variable in an experiment is the factor which the experimenter predicts will change in some way as a result of changing the independent variable—performance on the test in the case of the vitamin experiment.

The test of a hypothesis is what happens to

the dependent variable. If it changes in the predicted manner, the results are said to support the hypothesis; if the predicted change fails to occur, the hypothesis is not supported.

The effect of changing the independent variable can be determined only when the possible effects of all other variables which *might* produce change in the dependent variable are controlled. In the simplest experiment, these relevant variables are held constant throughout the experimental procedure; hence, any change in the dependent variable can be attributed to change in the independent variable. This process of regulating all relevant variables is called *experimental control*. This is not to be confused with *control of behavior*, one of the aims of scientific psychology discussed earlier. Here the term means that the influence of the relevant variable is the same for all subjects and does not change during the experiment.

In the experiment investigating the effects of vitamin X on memorizing prose, for example, such factors as willingness of the subjects to cooperate and room temperature, presence or absence of spectators, and amount of noise during testing would all be considered relevant variables, since changes in them might bring changes in the dependent variable.

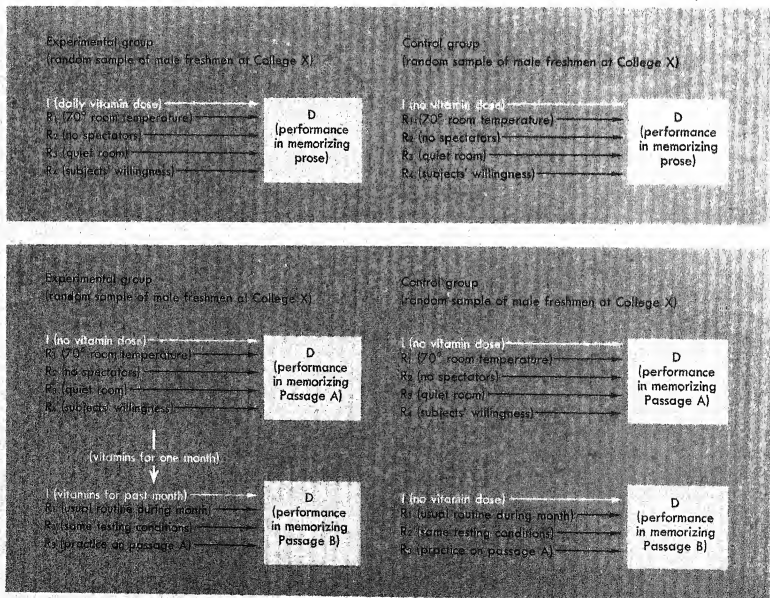
To study the effect of the independent variable, the experimenter must manipulate or vary it systematically. One way of doing this, using two groups of subjects, has already been described. Subjects in one group, the *experimental group*, receive a dose of the vitamin daily for a period of time and then memorize the passage; those in the other, the *control group*, do not receive the vitamin but memorize the same passage. The design for an experiment of this nature, with other relevant variables held constant, is shown in the diagram on page 28.

Another experimental design which enables the experimenter to manipulate the independent variable is to use the same experimental group on two different occasions, first testing their ability to memorize a prose passage without any vitamin being given and then, after administering vitamin X for a period of time, having them memorize a comparable passage. This design can lead the experimenter into trouble if he is not careful. First, the two passages may not actually be of equal difficulty.

DESIGNS FOR AN EXPERIMENT

In the experimental design shown in the first part of the diagram, conditions are the same for the experimental group and the control group except for the independent variable, I (daily vitamin dose for a month versus no vitamin dose). Since the other relevant variables, such as conditions during testing and willingness of the subjects to cooperate, are held constant, any difference between the two groups in the dependent variable, D (performance in memorizing prose), can be attributed to the difference with respect to the vitamin treatment.

In the somewhat more elaborate experimental design shown in the second part of the diagram, the experimental group is tested twice—once on Passage A before receiving vitamins and once on Passage B after receiving a daily dose of vitamins for a month. The control group gets the same learning tasks at the same times as the experimental group but receives no vitamins. Other relevant variables, such as activities during the intervening month and conditions during testing, are the same for the two groups. If both groups show the same amount of improvement on Passage B, the improvement may be attributed to practice on Passage A, to a difference in the difficulty of the two passages, or to some unknown factor other than vitamins. If the experimental group does better on Passage B than the control group does, the difference may be attributed to the fact that they received the vitamins and the control group did not.



Second, since each subject is exposed to two learning sessions, he is given some practice. If either of these factors affects the dependent variable (performance on the test), the results will be ambiguous. Suppose the subjects learn the first passage and are tested on it; they then receive a dose of vitamin X every day for a month, at the end of which they memorize another passage. There are two relevant variables that are not controlled. If an improvement is found, it might be due to the vitamin. It might also be due, at least in part, to practice or to the fact that the second passage was not as difficult as the first. If the experimenter knew to what extent performance is affected by these variables, he could allow for this difference in computing his results. Finding out how much improvement is due to these factors again requires a control group—in this case, a group whose members memorize *both* passages without receiving vitamins. This experimental design is shown in the second part of the diagram.

Using more than one independent variable. It is possible to study the effects of two or more independent variables in the same experiment. For example, we might hypothesize that age as well as vitamin X affects memorizing ability. If we were studying the effect of vitamin X only, age would be a relevant variable, which we could control by choosing subjects of the same age. If we wished to study the effects of both variables, however, we might use four groups: over twenty-one, given vitamin; over twenty-one, no vitamin; under twenty-one, given vitamin; under twenty-one, no vitamin. Here the dependent variable is still the performance on the memorizing task. The two independent variables are age and treatment with vitamin X. If the vitamin improves memory, the two groups who take it will do better. If age makes a difference, there will be a difference between the two older and the two younger groups. Thus, in one experiment, the effects of two independent variables are studied separately.

Interaction. It might be that the effect of one independent variable is dependent upon the other. For example, the vitamin might make a difference for younger subjects, but not for older ones. This is called *interaction*.

Let us consider another hypothetical example. A psychologist interested in the study of learning and aware of the widespread use of tranquilizers to reduce anxiety wishes to determine whether or not there is an interaction between the use of tranquilizers and the anxiety level of college students as these variables might affect grades on an algebra examination. Early in the semester he administers a test measuring degree of anxiety to a large class. At the time of the final examination, half of the more anxious students and half of the less anxious ones are given a large dose of a quick-acting tranquilizing drug. The other half of each group receives pills that look and taste exactly like the drug but are completely inactive. (Such a preparation is called a *placebo*.) When the papers have been graded, the averages look like this:

All anxious students	75
All calm students	75
Tranquilizer group	75
Placebo group	75

Apparently, neither anxiety nor the administration of tranquilizers has had any effect on performance. But suppose the figures are broken down further:

	Tranquilizer	Placebo	Combined
Anxious	90	60	75
Calm	60	90	75
Combined	75	75	

Here we can see interaction. The drug has apparently helped the anxious subjects and hurt the calm ones. If an experiment of this nature were actually to be performed, of course, it is extremely unlikely that the results would arrange themselves as neatly as in this example.

An interaction effect is clearly shown in an actual study of the productivity of factory workers. The purpose of the study was to investigate the effects of feelings about job security on the productivity of groups and to determine whether this relationship was influenced by the cohesiveness of the group.

The 288 groups studied ranged in size from five to fifty workers. The dependent variable in this case was group

productivity. The independent variables studied were (1) high security-low security and (2) high cohesiveness-low cohesiveness. Cohesiveness was determined by the extent to which group members tended to say, in response to a questionnaire, that they felt really a part of their group, that they preferred to remain in it rather than work in a different group, and that they perceived their group as better than others with regard to the members' liking or attraction for one another. As shown in the chart, highest productivity was found among the groups who were highly cohesive and at the same time felt highly secure in their jobs. * On the other hand, highly cohesive groups who felt a low degree of security in their jobs were lowest in productivity. Thus the effect of cohesiveness on productivity depended upon the job security of the group. Stated more abstractly, the relationship between productivity and cohesiveness is different for different degrees of security (Seashore, 1954).

The subject's attitude as a relevant variable. A number of psychologists have emphasized the fact that the subject's attitude toward a psychological experiment is rarely neutral (Festinger, 1957; Orne, 1962; Wishner, 1965). What he thinks the experiment is all about, what behavior he thinks the experimenter is expecting, how much he wants to please the experimenter,

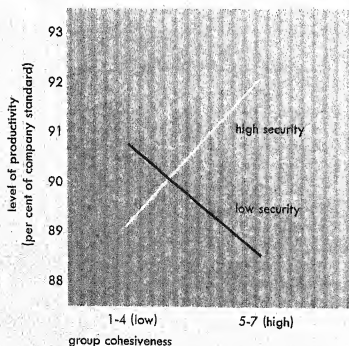
and how anxious he is to "make a good showing" may all influence the results and introduce bias into the findings. Clearly the experimenter would not be able to get a valid measure of subjects' tendency to conform to group opinion if the subjects knew that this was what he was studying. Other cases are not so obvious.

One of the best-known examples of the effects of subjects' attitudes on the outcome of an experiment involves the famous "Hawthorne effect." In a study of working conditions at the Hawthorne plant of Western Electric, a group of workers was studied over a period of several years during which working conditions were changed systematically in various ways. After every change, the productivity and morale of the group improved. Puzzled, the experimenters eventually reinstated the original conditions. Again there was an improvement. It turned out that the members of this group had appreciated the extra interest the management seemed to be taking in them and the special opportunities for freedom and sociability provided by their being set apart from the regular work force. It was their attitude toward the changing conditions rather than the characteristics of any of the situations tried by the experimenters that was responsible for their changed behavior. They had not even realized that they were producing more; they thought the work was getting lighter because they felt less tired at night (Roethlisberger and Dickson, 1939).

The experimenter must frequently control the subject's attitude toward the experiment or his knowledge of what it is about. In some cases, it may even be desirable that the subject remain completely unaware that he is participating in a psychological experiment. Here the question of ethics arises. To what extent is outright deception justified in order to keep subjects ignorant of factors where knowledge might affect their performance? What about studies in which subjects are given false information about their performance or about other members of the group?

For example, a psychologist wishing to study the effect of the feeling of failure in performing a task (independent variable) on subsequent performance (dependent variable) might use the following procedure. A group of students would be given a task to perform. Regardless of

● INTERACTION



Based on Seashore, 1954

their actual performance, half of the subjects would be told that they had done quite poorly and the other half that they had done extremely well. The stage would thus be set for observing the effects of this "knowledge" on further tasks.

Most psychologists feel that such deception is ethical if it does not lastingly injure the subject's self-respect or exert any other harmful influence on him that cannot be undone by a full explanation at the end of the experiment. But sometimes the effects of manipulating a person's emotions and attitudes, even in a laboratory experiment, cannot be predicted. A high sense of professional responsibility is clearly called for here.

Statistical Control and Analysis

Sometimes it is not possible or even desirable to rule out the differential effects of all relevant variables by means of experimental control. In such instances psychologists are often able to simulate controlled conditions by mathematical methods. This is called *statistical control*.

Suppose, for example, that an experimenter is studying the effects of age on golfing ability. In designing his experiment, he would want to study players who were in different age groups but as nearly alike as possible in such other respects as golfing experience, the kind of coaching received, the type and difficulty of the courses played on, and desire to play golf. Obviously, with so many variables involved, it would be extremely difficult to obtain groups perfectly matched in all respects. The experimenter might, for example, obtain groups which were equated on all variables except amount of previous experience. If this variable were left uncontrolled, the results of the experiment would be ambiguous. By using appropriate statistical formulas, however, the experimenter could determine the degree of relationship between playing experience and playing ability and then cancel out the effect of this uncontrolled variable on his results. In effect, a freely operating variable can thus be held "constant" mathematically.

Statistical analysis is used by psychologists in identifying the component abilities involved in

complex tasks and skills. Consider, for instance, the separate abilities required to solve a simple story problem in arithmetic, such as "John has 4 apples and gives half of them to his sister. Mary is John's only sister. How many apples does Mary get?" Although this problem seems extremely simple to you, the statistical technique of factor analysis has shown that your ability to solve it involves such distinct factors as reasoning and numerical ability. Factor analysts identify these abilities by constructing and administering test after test and analyzing the relationships among the scores. Tests having no consistent relationship to one another are presumed to be measuring different abilities. The use of factor analysis in the study of intellectual abilities and personality traits will be discussed in greater detail in Chapter 5.

How Methods Supplement Each Other

Often a complex problem has many aspects that need to be attacked by different methods. To see how these methods work together in actual practice, let us turn to an examination of the research being done by psychologists in an area of vital concern to the entire nation—the reduction of traffic accidents.

In the year 1965 an estimated 49,000 persons met death in motor vehicle accidents, a figure representing a 2.7 per cent increase over the record of the preceding year. The total cost of motor vehicle accidents in 1965, including medical expenses, insurance, overhead, lost wages, and property damage, has been estimated to be in the neighborhood of ten billion dollars (National Safety Council, 1966).

The Division of Accident Prevention in the Bureau of State Services of the Public Health Service was established in 1962. Through this agency the government supports research to (1) determine the causes and conditions that lead to accidents; (2) develop, improve, and evaluate means of preventing accidents; and (3) minimize the consequences of accidental impacts, poisonings, burns, or other injurious encounters. Psychologists are playing an important role in research of this nature—particularly in that directed toward the first two of these objectives.

Investigating the causes of accidents. Do accidents "just happen" or are they caused? If they are caused, the first step in an accident prevention program is to identify the conditions that bring them about. Only when the causes are known can steps be taken to remove them.

Many factors have been thought to play a role in accident causation, among them low intelligence, drinking, preoccupation with emotional problems, poor driving skills, unclear highway signs, and faulty highway design. What follows is just a sample of the ways in which psychologists investigate these personal and situational factors.

The accident-prone driver. Are certain persons so put together, through hereditary and environmental influences, that they will have more accidents in a given period of time than others exposed to the same degree of hazard (doing the same amount of driving with the same kind of equipment under the same conditions)? This is one of the questions asked by psychologists engaged in accident research.

It is a well-known and frequently repeated statement that a minority of drivers have the majority of accidents. By mathematics too involved to be explained here, it can be shown what the distribution of accidents would be if they happened by chance. If proneness is a factor, the *actual* distribution should show more persons with fewer accidents and more persons with more accidents than would be seen in the chance distribution.

This type of statistical analysis was applied to the accident records of 1294 taxicab drivers employed by several companies. The table compares the percentage of accidents to be expected in each group of drivers in a chance distribution with the percentage actually found (Mintz and Blum, 1949).

	Chance	Actual
Worse half of drivers	81.7%	82.8%
Worst third of drivers	63.9	69.3
Worst tenth of drivers	24.7	31.9

In interpreting this table, bear in mind that all of the drivers were relatively safe ones as compared to the general driving public. But even among these highly selected and well-trained

drivers, there were differences in susceptibility to accidents.

Records may also be kept as to whether or not people who have a disproportionate number of accidents in one period of time have the same experience in a similar period. This method is a somewhat unwieldy tool, however, since it requires an extensive period of investigation.

A study of factory workers bolsters the conclusion that people differ in their likelihood of having accidents. The table shows the percentage of workers in the worse half for the first period who were also in the worse half for the second period (Tiffin and McCormick, 1965).

Drill press operators	83%
Assemblers	84
Machine operators	77

If the distribution of accidents were solely a matter of chance, the values in such a table would be 50 per cent. It is apparent that workers who have more than their share of accidents in one period are likely to have more than their share in the future. Studies like the two just cited give a sound scientific basis to the administrative practice of dismissing drivers or other workers who have had a consistently greater number of accidents than the average employee.

Another approach to the problem of understanding accident proneness is through the use of aptitude and other tests. In one study of this kind, it was found that 71 per cent of the passenger car drivers who had passed a visual test had had two or fewer accidents during a given period of observation, while only 42 per cent of those who failed the test had equally good records (Tiffin and McCormick, 1965).

A recent study of ninety patrol car officers of a large city police department has shown that appropriate aptitude tests can predict accident rate even in a highly selected and well-trained group of drivers (Ruch, 1965). The results of this study are shown in the following table.

	Passed Tests	Failed Tests
No accidents	63%	22%
1 accident	24	30
2 accidents	8	26
3 or more accidents	5	22

Here again we see a substantial relationship between test scores and susceptibility to accidents. Such a relationship would be much greater among drivers in the general public.

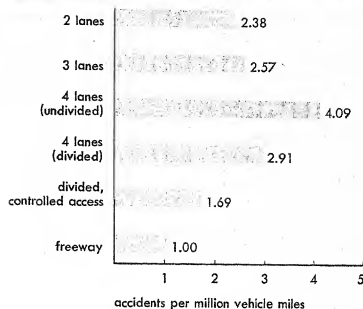
Some investigators have used the clinical interview in studying the personalities of people who consistently have accidents. In one study, such persons (hospitalized at the time for fractures) were found to be highly aggressive, impulsive, and intolerant of social or family control (Dunbar, 1943). Unfortunately, this study lacked adequate experimental controls and cannot be taken as conclusive.

A more thorough study has been conducted by two physicians, one of whom spent the better part of three months in constant association with a group of forty taxicab drivers. This field study was augmented by intensive fact-finding efforts which included checking the records of police, juvenile court, and social welfare agencies.

The significant findings for the twenty high- and twenty low-accident drivers are given in the following table. (Tillmann and Hobbs, 1949).

Personality Characteristics	High- accident	Low- accident
History of parents		
Parents divorced	6	1
Excess strictness and disharmony	13	5
Neurotic traits in childhood		
Excess childhood fears	11	5
Excess aggression in childhood	11	0
School adjustment		
Truancy and disciplinary problems	12	2
Employment record		
Five or more previous jobs	13	7
History of being fired	10	4
Armed service record		
Frequent A.W.O.L.'s	11	1
Sexual adjustment		
Admitting sexual promiscuity	8	2
Social adjustment		
Having two or more hobbies	9	17
Admitting bootlegging on job	14	3
Conscious of physique	11	3

▲ ACCIDENT RATE AND HIGHWAY DESIGN



Based on American Safety Foundation, 1963

Obviously, poor personal and social adjustment is associated with high accident frequency among taxicab drivers.

Environmental factors in automotive accidents. Efforts to understand the causes of accidents include those made by psychologists in cooperation with engineers to determine what design features are conducive to safe or dangerous driving. A recent study of highway design in relation to accident rate is summarized in the graph.

Many studies of this nature are required to evaluate the effectiveness of such highway and street design features as stoplights, road signs, and the like. Of equal importance are studies of mechanical design features of the motor vehicles themselves, such as tinted windshields, power steering, and many other devices. In all of these the psychologist can bring his expertise to the aid of the engineer.

The experimental approach to accident prevention. One very reasonable hypothesis of accident causation is that the high-accident driver is the one with poor driving habits and attitudes. If this should prove to be the case, a carefully designed program of driver training should be a valuable tool in the prevention of acci-

dents. To test this hypothesis a controlled experiment was conducted with 119 truck drivers.

The drivers were divided into two groups, one of which was trained according to a well-known and highly respected system of driver education for a period of one to four weeks. The other group, which received no training, served as an experimental control. Accurate records were kept of miles driven and of all accidents, both avoidable and unavoidable. The following table presents the accident experience of the two groups over the fifteen months following the training period (Payne and Barmack, 1963).

	Accidents per 100,000 Miles Driven Avoidable	Unavoidable
Trained drivers	.43	.54
Untrained drivers	.61	.52

The table shows that the untrained drivers were involved in more avoidable accidents than were the trained drivers. However, the number of cases involved is so small that these results cannot be accepted with confidence. Further stud-

ies of this and other training systems are needed.

The use of education and other countermeasures to change attitudes is becoming an important adjunct to traditional enforcement measures. Unfortunately, it is difficult in civilian life to gain sufficient control over the numerous variables that might affect driving skill to permit worth-while experimentation. A military base, however, offers a good situation for such investigations because it is possible to control the experimental variables more closely. The following well-designed evaluation of the countermeasures used on an Air Force base reveals much information that could be used in civilian programs.

An analysis of off-base, off-duty driving behavior revealed that 64.5 per cent of drivers involved in accidents had been drinking—most of them heavily, to the extent of six or more drinks, as against only 5.6 per cent in a randomly selected control group not involved in accidents. The purpose of the countermeasure program was to undercut the favorable image of such behavior—to establish the "tank up and take off" philosophy as the mark of a sick personality rather than that of a hero.



■ The Chicago Police Department, in cooperation with the Circuit Court, runs a traffic school for persistent traffic violators judged to be in need of schooling in the fundamentals of safe driving. In an 8-hour course, through lectures, films, discussion, and practice in simulated traffic situations, teacher and class together analyze the driving problems that can lead to accidents. Not until the last lesson do the class members discover that their teacher is a policeman.

Accordingly, the base commandant announced and publicized a program of countermeasures. Any airman who became involved in a lost-time injury accident while driving a privately owned motor vehicle was "tagged" for special attention. His records were reviewed by his commanding officer for evidence of ineffectiveness which could lead to separation from the service. The commanding officer could also refer the driver to the base psychiatrist. The psychiatrist had three actions open to him: (1) return the airman to duty without further action; (2) offer psychiatric treatment if the man seemed to need it; and (3) recommend discharge on medical grounds if appropriate. As it turned out, no driver was recommended for discharge, and psychotherapy was felt to be required in only two cases.

A program of educational materials was prepared and disseminated via the base newspaper, bulletin board, and commander's call meetings. A total of eighteen pieces of material were used, most of them parts of an investigator's report of statements made by the drivers who had caused accidents. These were selected to give a poor image of such persons, as the example shows:

"I have been court-martialled a couple of times. Once it was for AWOL. I got tired of the NCO riding me, so I took off. It was only a couple of days—they said eight. I got a summary court for that. . . .

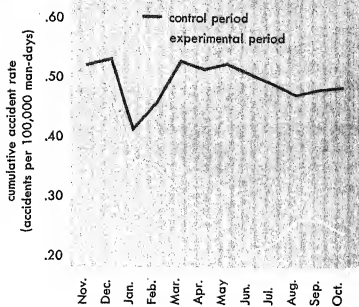
"I was upset [the day of the accident] because my wife went off to stay with some people. We had a fight. I went to a friend's house. We killed a fifth between four o'clock and seven o'clock. Maybe I had ten or twelve shots.

"I was going back to the base. I was thinking about my wife. I saw the light changing from green to amber, but I thought I could make it. They say I hit a car coming through the intersection. They took me to the hospital, but I don't remember any of it. I woke up with a terrible headache. I've been in accidents before, but never one where I got hurt. I guess I should have been paying more attention."

The countermeasure program was in effect for twelve months. The decrease in accident rate during this period can be seen in the chart. Notice that the change did not become noticeable until the third month but continued for the remainder of the year.

Another clear evidence of the effectiveness of the Lackland program is seen in comparing their experience with that of nearby Randolph Air Force Base. The accident rate among Randolph personnel during the period of the study was about the same as it had been in the year before, while that at Lackland was cut in half (Barmack and Payne, 1961).

CHANGE IN ACCIDENT RATE



Based on Barmack and Payne, 1961

Further studies of the methods employed at Lackland are required to determine which of the devices used are most effective and to learn if there is any way similar procedures can be used effectively with large groups of civilian drivers.

CHAPTER SUMMARY

Although psychology is a relatively new science, attempts to explain human behavior are very old. Early attempts, however, were philosophical rather than scientific; *demonology* was frequently used to explain puzzling or undesirable behavior. It was not until the Renaissance that true science was born.

Modern psychology owes a great deal to *experimental physiology* and to the early study of *psychophysics*. Psychology as a separate science was first established in 1879, when Wundt set up a laboratory for the *introspective anal-*

ysis of conscious experience. Wundt and his followers came to be known as *structuralists*. Gradually other groups of psychologists began to emphasize other aspects of behavior. The *functionalists* emphasized the processes by which man adjusts to his environment; the *behaviorists* limited their study to overt behavior that could be observed objectively and stressed the importance of stimulus-response connections; the *Gestalt school* stressed the importance of studying total patterns of behavior rather than isolated elements; and the school of *psychoanalysis* stressed the role of unconscious mental processes in personality development and disorders.

Psychology, defined as the *science of the behavior of organisms*, is greatly aided by her sister sciences *biology*, *anthropology*, and *sociology*. In fact, a new discipline called *behavioral science* coordinates the work of these sciences in studying human behavior in group situations.

Nearly half the 25,000 psychologists in the American Psychological Association teach and do research in colleges and universities. Some are primarily science oriented, others primarily people oriented. Your author advocates a middle course.

Among the important fields of *applied psychology* engaged in by nonacademic psychologists is *clinical psychology*. This includes *psychodiagnosis*, the total study of an individual to determine his present psychological functioning in relation to past events, and *psychotherapy*, or treatment of his difficulties. Therapy may be carried out in a clinic, often in cooperation with a psychiatrist, in a hospital or a correctional institution, or in private practice. The psychologist who likes young people but does not care to teach may become a *school psychologist*, performing such duties as psychological testing and guidance counseling. Many psychologists perform similar functions in *industry*, where they may also engage in *human engineering*—adjusting the job to the employee. Still other psychologists enter *government service*, engage in *private practice*, or enter the third major area of psychology—*research*.

The research psychologist uses a variety of scientific procedures to discover principles which will enable him to *describe*, *understand*,

predict, and *control* behavior. In obtaining data, he is careful to avoid subjective bias, making use of blind tests whenever possible. Facts gained through such observation are classified into meaningful categories. Classification can be either *qualitative* or *quantitative*, although the latter is usually preferable because it makes possible more precise predictions. Facts must be organized into *principles* and principles into orderly, logical *theories* if maximum understanding is to be gained. The value of a theory is measured in terms of its ability to explain the relationships among facts and to suggest *hypotheses* which may be experimentally tested. When the aim of research is understanding as an end in itself, it is known as *pure science*, as distinguished from *applied science*, which seeks knowledge for some practical purpose. However, in modern social science this distinction is regarded as artificial and is disappearing. For accurate prediction it is necessary to identify a consistent relationship between persons, events, situations, and conditions. As the psychologist gains in ability to make accurate predictions about behavior, he comes closer to reaching his fourth objective—control. The possibility of effectively controlling human behavior, which often involves modifying it, has far-reaching implications for benefit or harm and thus places a great responsibility on psychologists to see that their science is used for the good of mankind.

The most basic technique in psychology is *observation*, which may be either *introspection* or *objective observation*. Often the two are combined. Like physicists, psychologists must interpret their observations cautiously, bearing in mind the *uncertainty principle*, namely, that an event may be changed by the presence of an observer. The use of *operational definitions* of conditions being investigated is a further precaution. Often the psychologist uses a *logical construct* to explain what happens in his experiment. That is, he imagines the existence of a quality or substance or process by which the observable behavior is shaped. When such constructs have been used in enough experiments to have developed a constant form, they are known as *intervening variables*.

Among the methods of study used by psychologists are the *field-study* method and the

life-history methods, including the *daybook*, the *clinical* (which both compiles information and attempts to modify behavior), and the *biographical*. For certain investigations the *survey* method is most feasible. However, the most rigorously scientific of all is the *experimental method*, in which hypotheses are tested under carefully controlled conditions. To maintain *experimental control*, the psychologist tries to hold constant all *relevant variables* except the *independent variable*, which is allowed to operate freely so that its effects upon the *dependent variable* can be studied. He must bear

in mind that the changes in the dependent variable will often be the result of *interaction* between two variables. When it is impossible to control all relevant variables experimentally, the method of *statistical control* may enable the experimenter to simulate controlled conditions mathematically. *Statistical analysis* makes possible the study of complex skills involving the interaction of several abilities. In tackling a complex practical problem, such as the prevention of accidents, it is common for a number of different methods to be used in combination.

Chapter 2

Outline

ORGANIC ADJUSTMENT

MAN FUNCTIONS AS A WHOLE IN ADJUSTING
THE ORGANS OF ADJUSTMENT
STIMULUS, ORGANIZATION, RESPONSE, AND FEEDBACK

THE SENSORY-MOTOR ARC

THE SENSORY-MOTOR ARC
THE NEURON

THE SPINAL CORD

THE DISTRIBUTING SYSTEM OF THE SPINAL CORD
THE ADAPTIVE NATURE OF REFLEXES
INHIBITION AND RECIPROCAL INNERVATION

THE BRAIN—THE HIGHEST ADJUSTED BODY

HOW SCIENTISTS STUDY THE BRAIN
MAIN PARTS OF THE BRAIN
LOCALIZATION OF FUNCTION IN THE CEREBRUM

THE ENDOCRINE SYSTEM

THE PITUITARY
THE THYROIDS
THE ADRENAL GLANDS
THE GONADS

Chapter 2 The Biological Bases of Behavior

The dividing lines between the various sciences, as we saw in Chapter 1, are less distinct than they would appear at first glance. The physiologist, for example, must be reasonably conversant with modern physics and chemistry. The sociologist must have more than a nodding acquaintance with anthropology and psychology. In fact, in modern research laboratories the concept of interdisciplinary research is highly regarded, and many valuable contributions to human knowledge have been made by teams of workers representing different scientific disciplines.

The psychologist, whose primary interest is human adjustment, must have a thorough background in physiology. He must know something about the organs of adjustment, especially the brain and nervous system and the wonderfully complex, interacting endocrine gland system. In this chapter an overview of these systems will be given as a background for the understanding of many of the specifics of human behavior, for without these structures there could be no human behavior or conscious experience.

BEHAVIOR AS ADJUSTMENT

Modern psychologists see man as an *organism*—a living being made up of interdependent parts (organs) which, working together, enable it to meet demands made on it. Psychology is concerned with the *adjustive behavior* through which man meets these demands, whether they derive from his biological needs or those of social origin. If an individual is thirsty, he may

seek a drink of water; if he is badgered by his mother, he may rebel. Both responses are adjustive. Because activity may be initiated by conditions outside his body or within his own tissues and physiological processes, psychologists distinguish between his *external* environment and his *internal* one, though of course no sharp line can be drawn between organism and environment.

Adjustment to inner and outer demands is a continuing and never-completed process: as long as a person lives, he is adjusting. Sometimes he adjusts by changing his surroundings, as when he builds a house for shelter or moves to another town to find a better job. Sometimes he adjusts by changing himself, as when he goes to night school to improve his opportunities for promotion. Whatever form adjustment takes, it always involves a complex relationship between the individual's needs, the opportunities provided by his particular environment, and his competence in using the resources available to him.

Man Functions As a Whole in Adjusting

Normally many activities are going on at once in the human organism. Yet man behaves as a whole in the sense that, even though he may be reacting to an intricate pattern of conditions, he does only one main thing at a time (Sherrington, 1941). For example, as a person drives along in a car he may at the same time be mentally reviewing for an examination or thinking about last night's date. Other secondary activities, such as breathing, sweating, and hearing surrounding noises, are also taking place. But still he obeys the traffic signals, for he is doing one main thing at a time—driving a car.

The secondary activities, if they are to persist, must either support the main thing that is

being done or at least not seriously interfere with it. When an activity is antagonistic to the one main thing, it tends to be suppressed, or *inhibited*. Under normal conditions all of one's activities are smoothly integrated. *Man functions as a whole.*

The Organs of Adjustment

The organs of the human body are classified into two chief groups, according to whether they (1) function internally to maintain the individual's health and growth or (2) function in the individual's activities in the environment as he overcomes obstacles to the satisfaction of his needs. The first group, called the *organs of maintenance*, includes the heart and blood vessels, the lungs, the alimentary canal and its digestive glands, and the liver. The second group, known as the *organs of adjustment*, includes the muscles, the skeleton, and certain glands. The organs of adjustment enable the organism to carry on such activities as finding food, mating, and working. The organs of maintenance and adjustment are coordinated and regulated by the endocrine glands, which work through the circulatory system, and by the central nervous system.

Stimulus, Organization, Response, and Feedback

The building blocks of the psychologists have traditionally been stimulus and response. The word *stimulus* (plural *stimuli*) comes from the Latin word meaning "goad." In psychology a stimulus is regarded as some form of radiant, chemical, or other energy which, if sufficiently strong, acts on a specially sensitive tissue in the eye, ear, skin or other sense organ, setting off nerve impulses. Thus a doorbell is a stimulus object, and the sound waves it emits are stimuli that enter a person's ear and create the sensation of hearing—perhaps leading to the *response* of going to the door.

A very brief and inadequate formula for adjustable behavior is $S \rightarrow R$, where *S* stands for stimulus and *R* stands for response. Early experimentation inspired by this oversimplified

model consisted, for the most part, of varying stimuli in systematic ways and observing the changes in response, in an attempt to discover consistent relationships between stimulus conditions and given responses. Such relationships are not invariable, because consequences of past behavior and the presence of various processes within the organism, especially in the brain and nervous system, can influence the behavior that follows a given stimulus.

It is generally assumed that when a response (behavior) is observed, there must have been a stimulus to produce it. If no stimulus is apparent, an internal one has been postulated. Laboratory studies have shown that in some cases an internal stimulus may be applied directly to a nerve cell rather than to a sensory receptor cell. The organism is never immobile and passive in the absence of external stimulation to arouse it to action. Instead it is constantly active, scanning its surroundings, monitoring its own actions, seeking certain conditions and avoiding others. Stimulation may serve as a *goad* to action but external stimulation is not essential for action. Such stimuli may serve only to *guide* behavior—as a source of information to be used in improving an ongoing action or stored for later use.

The Gestalt psychologists have been the severest critics of the $S \rightarrow R$ formula. One of them has this to say:

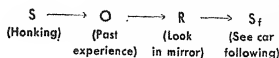
"The stimulus-response formula, which sounds at first so attractive, is actually quite misleading. In fact, it has so far appeared acceptable solely because Behaviorists use the term 'stimulus' in such a loose fashion. . . . When the term is taken in its strict sense, it is not generally 'a stimulus' which elicits a response. In vision, for instance, the organism tends to respond to millions of stimuli at once; and the first stage of this response is organization within a correspondingly large field. . . . The right psychological formula is therefore: *pattern of stimulation—organization—response to the products of organization.*" (Köhler, 1947, pp. 164-166)

Most psychologists today prefer the $S \rightarrow O \rightarrow R$ model, where the *O* inserted between the *S* and the *R* symbolizes the internal conditions and organizing processes which, although difficult or impossible to observe at times, are logical

constructs essential to our understanding of the behavior we see.

One more term must be introduced in the picture of the organism as an adjusting system to round out the picture. Both the $S \rightarrow R$ and the $S \rightarrow O \rightarrow R$ formulas give the impression that a unit of behavior is terminated by the muscular or glandular response, R . This is far from the case. Typically the response produces some change in the environment which, in turn, leads to further action. While driving, you hear an automobile horn honking— S . Past experience causes you to seek an explanation— O . You glance in the rearview mirror— R —but your response does not stop at that point. You see another car following closely, and you re-

spond by pressing harder on the accelerator. Your response of looking in the mirror supplied *sensory feedback*, which served as a new stimulus. Thus we see that our formula will not be really adequate unless we add the element of sensory feedback:



Sensory feedback, since it aided in adjustment, can be expected to affect the tendency to look in the mirror when an aid to adjustment is needed in a similar situation in the future.

THE BASES OF NEURAL FUNCTIONING

Although psychologists and neurologists still have much to learn about our brains and nervous systems, they are sure that underlying every thought, every perception, and every action is a pattern of neural activity. As we encounter stimulus situations of all kinds, messages are received, evaluated, integrated, and stored, and other messages are sent out to the various organs of response. Clearly, any complete understanding of man's behavior must eventually include an understanding of the neural mechanisms underlying these activities.

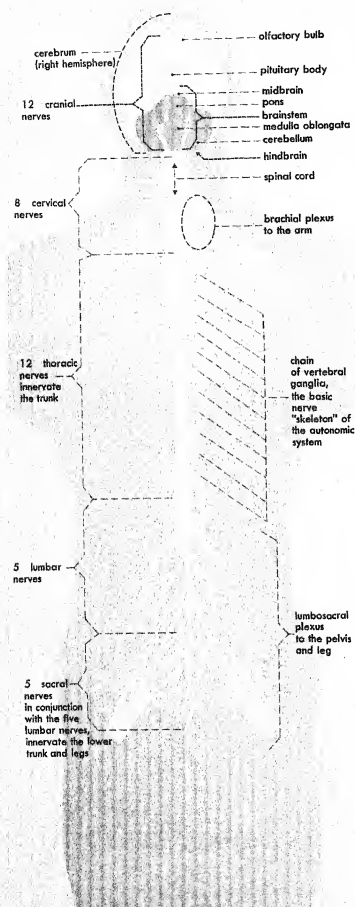
Neurology, like psychology, is a relatively young science. Most of what we know about the nervous system and its functioning has been learned in the last hundred years—much of it in the last twenty years. But there still is much to learn. Although today's knowledge is far from complete, great progress has been made in identifying the important neural structures and in discovering how they function as we think and feel and act. In this chapter we shall examine some of the findings about neural activity which have special relevance to the field of psychology.

The nervous system, though simple in principle, is actually an extremely complex structure. As you try to grasp the essential concepts in regard to its form and functions, it will be easy to get lost in the maze of details that must be given for an adequate picture. Therefore, to give you the thread of the discussion to come, the main points to be covered are listed on pages 42-43. It is recommended that you read this summary once before going further in the chapter and again when you have finished reading the chapter.

The Sensory-Motor Arc

Underlying every simple movement or complex act of the human organism is a chain of neural structures making such behavior possible. In its simplest form this chain is known as the *sensory-motor arc* and generally consists of five elements, which are described below. These are: (1) *receptors*, (2) *sensory nerve fibers*, (3) *connectors*, (4) *motor nerve fibers*, and (5) *effectors*. These elements of a simple sensory-

THE NERVOUS SYSTEM: AN OVERVIEW



THE CENTRAL NERVOUS SYSTEM

1. A single nerve cell, which is the structural unit or building block of the nervous system, is called a *neuron*. It has all the characteristics of living cells in general and in addition is specialized to receive and carry electrochemical messages (nerve impulses). The neurons correspond very roughly to the single wires in a complex telephone system. As with all cells, each neuron has its own nucleus. The part of the neuron in which its nucleus is located is approximately spherical in shape and is known as the *cell body*. The cell bodies are mostly collected in bunches (*nuclei*) within various parts of the central nervous system, but some cell bodies are gathered in small clusters (*ganglia*) elsewhere in the body.

All neurons have two types of fiber-like extensions: various numbers of dendrites and one axon. Dendrites, which, along with the cell body itself, "receive" nerve impulses, are typically short, multiple, and branched. The axon may also be branched and may be either short, like the "patch cords" on a switchboard, or quite long. It transmits the nerve impulse to other neurons or to muscles or body organs.

2. A number of axons, or nerve fibers as they are sometimes called, are frequently gathered into bundles that have a common place of origin and destination. Within the central nervous system such bundles are known as *nerve pathways* or *tracts*; when the bundles connect the central nervous system with other parts of the body, they are called *nerve trunks* or simply *nerves*. Some nerves in the body (but never in the brain) contain both motor and sensory fibers.

3. The receptor-connector-effector process operates through the passage of electrochemical nerve impulses along individual nerve fibers. At the point where one neuron "contacts" another (the *synapse*), the nerve impulse from one cell is capable of initiating an impulse in the next neuron in line.

4. The sensory-motor arc is the simplest functional unit of the nervous system. Nerve cells in such an arc are linked in chains of two or more to connect receptor cells with cells in some organ of response. A basic chain consists of a sensory or *afferent* neuron leading from a sensory receptor, usually one or more connector cells, or *interneurons*, within the spinal cord or the brain, and the *efferent* neuron, or *motoneuron*, leading outward to some muscle. (Slightly different terminology is used in describing the nerve supply to the glands.) A sensory-motor arc is also called a *reflex arc* because the impulses going to the central nervous system are

"reflected" back to the muscles, often muscles near the sense organ.

5. In addition to the afferent fibers leading from receptors into the brain and the efferent fibers leading away from the brain to the muscles and glands, there are special efferent fibers going down from the higher centers to lower relay points for incoming sensory messages and even out to the receptors. These special efferent fibers have a "gating" effect, blocking off the incoming sensory messages or permitting their passage, depending on the ongoing activity and needs of the organism. This is one of the mechanisms that enables the organism to do one main thing at a time.

6. The vast majority of neurons connect two points within the central nervous system and are called *interneurons* or *connector neurons*. Some interneurons with a short, multiple-branched axon provide a distributing system through which, for example, incoming sensory information can be shunted eventually to many motoneurons and muscles. Other connector neurons, with long axons, carry messages from the spinal cord up to the brain for correlation at "headquarters."

7. The nervous system as a whole has two parts: the central and the peripheral. The *central nervous system* is made up of the brain and spinal cord. Its function is to correlate and integrate—to make the various parts of the body work together. The *peripheral nervous system* consists of nerve fibers passing from the receptors to the central nervous system and of fibers passing from the central nervous system to muscles and glands. These peripheral nerves connect the central nervous system with all the receptors and effectors throughout the body. The central nervous system and the stumps of the peripheral system are shown in the drawing; the brain has been drawn as it would appear if it were tilted upward and back in the skull.

Both the central and the peripheral nervous systems have *somatic* components, which control the skeletal muscles, and *visceral* components, which control the glands and the special kinds of muscle found in the heart, blood vessels, eyes, and internal organs, or viscera. In general, the somatic muscles can be controlled voluntarily, whereas the visceral ones cannot.

In the central nervous system, these somatic and visceral components are largely intermingled, but in the peripheral nervous system they are more separate and often run in different nerve trunks. The visceral portion of the peripheral system is called the *autonomic nervous system*.

The autonomic system, which is diagramed in detail on page 429, includes fibers going to and from the

various internal organs as well as to the sweat glands and to the blood vessels of the skin and muscles. Some of the coordinating work of the autonomic system is done outside the central nervous system in the *sympathetic chain*, a chain of ganglia lying just outside the spinal cord, and in ganglia near or actually within the walls of the internal organs. The neurons running to these ganglia, *preganglionic fibers*, are comparable to interneurons and constitute a distributing system. Fibers running from the ganglia to glands or to the hollow organs, *post ganglionic fibers*, are comparable to motoneurons. The two parts of the autonomic system—the *sympathetic* and the *parasympathetic*—originate from different sections of the brain stem and spinal cord and, in general, oppose each other's functions. The way in which they act together is discussed in some detail in Chapter 12.

8. The nervous system functions at three levels of complexity:

a) Simple, unconscious processes, such as the reflexes, are made possible for the most part through connections located in the spinal cord and an extension at the top of it known as the brain stem.

b) More complex processes, such as standing, walking, and breathing, are made possible by structures in the brain stem. The *cerebellum* controls equilibrium and aids the motor systems of the brain in carrying out well-coordinated voluntary movements; the *thalamus* organizes and transmits sensory impulses to the cerebral cortex; and the *hypothalamus* plays an important role in biological drives such as hunger and thirst, in emotion, and in the regulation of the visceral organs. These parts of the central nervous system, along with some structures deep inside the cerebral hemispheres, are sometimes collectively called the *old brain* because they developed first in the course of evolution. As we pass from the lower to the higher animals, there is more and more *encephalization*—that is, the higher parts of the brain, particularly the cerebral cortex, are proportionately larger and make possible greater precision and flexibility in adjustment.

c) The evolutionarily newer *cerebral cortex*, the outer covering of the cerebral hemispheres, is an extremely complex collection of cell bodies and interconnecting nerve fibers. Parts of it are organized to receive sensory information from the environment and to help initiate voluntary movements. The cerebral cortex also contributes crucially to such complex processes as learning and thinking, although it is now becoming clear that such higher mental processes are dependent on contribution from the old brain as well.

motor arc are pictured in simplified form in the diagram. ♦

The receptors are those structures in the nervous system which are sensitive to stimuli. Some receptor cells are in contact with the external environment; others are sensitive to internal stimuli. Receptor cells located in a joint, for example, respond to changes in the angle of that joint and give rise to the perception of body position. Other cells can detect changes in blood chemistry and tell the brain that you are hungry or thirsty.

For most of man's "senses" there are specialized receptor cells which serve to transduce environmental energy into nerve impulses. This generalization does not hold for the skin senses, in which some receptors are simply the branching of sensory neurons and others are associated with nonneural cells such as hair roots.

A receptor cell for a particular sense, with its related neural mechanism, is sensitive only to certain stimuli. Sight receptors, for example, are not sensitive to sound stimuli, nor receptors for hearing to odors. The fact that the receptors for each sense will normally respond only to specific stimuli is an important principle of physiological psychology. The receptors for the various senses will be discussed in Chapter 8.

Between the receptors and the effectors are the brain and nervous system, which will be our main concern in this chapter. These consist of billions of individual nerve cells called *neurons*. The excitation set up in a receptor by a stimulus is transferred as a *nerve impulse* along a sensory nerve fiber. This is also known as an *afferent* nerve fiber because it carries messages toward the center (*afferent* is from two Latin words: *ad*, meaning "toward," and *fero*, meaning "carry").

The vast majority of neurons serve as connectors. A complicated chain of *interneurons* carries nerve impulses throughout the central nervous system. With few exceptions, the connecting pathway passes through the central nervous system—through either the spinal cord, the brain stem, or the higher brain centers in the forebrain. Psychology texts that were in use twenty-five years ago usually compared the brain to a telephone switchboard, but today we realize that this is a rather poor comparison and that an electronic computer provides a better

model. Instead of merely relaying impulses, as a switchboard does, the brain takes an active role in *organizing* and *directing* the behavior of the human body (Hebb, 1949). The more complex the structure of an organism, the more important these connecting mechanisms seem to be in coordinating and directing responses.

The motor nerve fibers carry nerve impulses away from the center or point of connection. They are also called *motorneurons* or *efferent* fibers (from *ex* and *fero*, meaning "away from" and "carry").

In the simplest sensory-motor arcs there are only two nerve cells, an afferent one sensitive to stimuli and an efferent one going directly from this cell to an effector. However, in most sensory-motor arcs the sensory and motor nerves are linked by one or more interneurons. Complicated arcs may involve many of these nerve fibers.

Hundreds of nerve fibers are involved in even the simplest stimulus-response act. Each sensory-motor arc is duplicated many times. In the central nervous system, most neurons transmit impulses to many other neurons. Often the duplicate connections lie side by side, but there are numerous instances in which the duplicates take quite a different course in going through the nervous system from the receptors of the sense organs to the effectors. This state of affairs is fortunate indeed, since when one portion of the system is injured or diseased, alternate pathways can still carry out some adaptive responses.

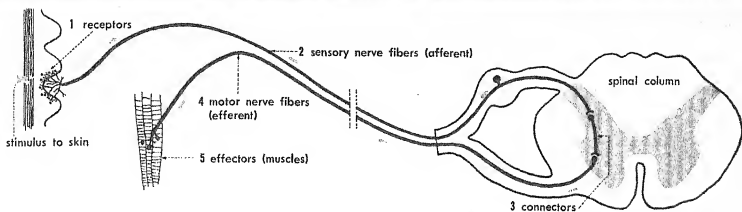
The great number of potential pathways also makes possible a variability of response to identical stimuli. The brain is especially rich in such alternatives. Thus, while responses involving only connections within the spinal cord are fairly stereotyped, those in which the brain is involved are capable of almost infinite modification.

The effectors are the organs of response, which perform the actual adjustive actions of the organism. These are the muscles, which contract, and the glands, which secrete. Their action involves manipulating objects in the external world or changing the condition of the individual in relation to his environment.

Suppose, for example, that the temperature of the room in which you are studying becomes too high for comfort. Your most likely response

◆ A SENSORY-MOTOR ARC

Response to a stimulus requires all five of the steps shown in this diagram except in rare cases where there is no connecting neuron in the spinal cord. No response will be able to take place if the stimulation is too weak or of a kind to which the receptors are not sensitive, or if the neural impulse fails to cross any of the synapses in the chain, or if the impulse finally reaching the effectors is too weak to activate them, or if the effectors are unable to respond (perhaps because of fatigue). A single chain is drawn here with one interneuron. Actually, this simple arc is duplicated many times in a stimulus-response act, and typically interneurons bring involvement of segments of the spinal cord above and below the one shown.



would be to turn off the radiator valve. In this way the action of a group of muscles in response to the stimulation of a group of receptors would bring about a change in the external world. Glandular responses may also help to make the world more livable or more easily manipulated. A bit of dirt gets in your eye, and tears are secreted which wash the foreign matter away, ending the discomfort and preventing injury to the eye.

The Neuron

The "building block" of the nervous system is the single nerve cell, the *neuron*. Like all other cells, it is made up of protoplasm (living substance) surrounded by a thin, living membrane.

Anatomy of the neuron. Each neuron has a *cell body*, a thickened portion containing a *nucleus*. This nucleus can be seen under the microscope if brain or neural tissue is imbedded in wax, cut in thin slices, and colored with certain dyes. Any portion of a neuron which is

cut off from its nucleus will die and disintegrate. Anatomists can map the pathways of the nervous system in animals by destroying the part of the neuron containing the nucleus and then, with the aid of a microscope, tracing the degeneration of the rest of the neuron wherever it goes throughout the nervous system. The degeneration stops at the end of the neuron, indicating the validity of considering it the structural unit of the nervous system. Another type of degeneration useful in tracing neural pathways occurs in the cell body when its axon is cut; this is called *retrograde*, or backwards, degeneration. Although definite changes occur in the cell body, the entire cell does not die and the changes may even be reversible.

At each end of the cell body are slender fibers—at one end the *dendrites* and at the other, the *axon*. Dendrites are highly branched and usually quite short. They, along with the cell body itself, are the receiving elements of the nerve cell, taking in impulses from receptor cells or from other neurons. The axon serves to transmit impulses to other nerve cells or to muscle fibers. Axons terminate in *end brushes*.

those of motoneurons are generally called, *end plates*.

Kinds of neurons. Neurons vary widely in size and shape, depending upon the function they perform and the distance they extend. On the basis of function, neurons are divided into two classes. The *long-conducting neurons* make up the peripheral nerves and the long pathways of the central nervous system. These have long, single axons or, in the case of afferent neurons, a long dendrite. All the peripheral sensory and motor fibers are of this type. Near their termination they branch and give off *collaterals*, thus making contact with many other cells.

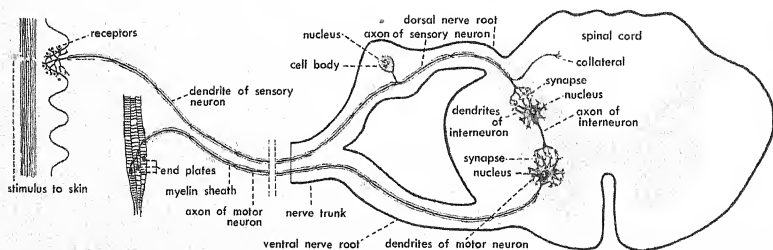
Axons and their collaterals of large diameter are encased in a fatty white covering known as the *myelin sheath*; the thinner ones are said to be *unmyelinated* because no sheath is visible with the ordinary light microscope. Not all the myelinated pathways are so at birth, and, for some reason not yet understood, nerve fibers which are destined to become myelinated do not function until their myelin sheath is formed. This probably explains why infants

cannot carry out many activities. Myelination is part of the process of maturation to be discussed in Chapter 3.

Interneurons have a number of short dendrites and a short axon, the latter often having many collaterals. Neurons of this type provide many connections and alternative pathways. The central nervous system contains both types of neurons; the peripheral system has only long-conducting ones.

Nerve impulses. The impulse traveling along a nerve is in some ways similar to an electric current, and it can be detected and studied with electrical instruments. But a nerve impulse differs from an electric current in several important ways:

1. An electric current flows with the speed of light (about 300,000,000 yards per second), while the slowest nerve impulse travels about one yard a second—less than a tenth as fast as a good sprinter can run.
2. An electric current passing through a wire gradually diminishes, especially in a wire that has high resistance, and does not retain its original strength even in going through low-resist-



KINDS OF NEURONS

This is a more detailed drawing of the sensory-motor arc shown on page 45. Three kinds of neurons are represented here: a sensory (afferent) neuron with its long dendrite and relatively short axon, an interneuron, with its many branches, and a motoneuron, with a collateral and a long axon ending at effectors. In a sensory-motor arc, all synapses are in the spinal cord.

ance wire; nerve impulses, on the other hand, are as strong when they reach their destination as they were at the start. Although they may become weak, as in going through a segment of nerve poisoned by alcohol fumes, they build up strength again when they reach a normal stretch of nerve.

3. A wire (for example, a telephone wire) can conduct thousands of impulses per second, but nerve fibers can conduct only several hundred per second. No matter how fast the stimuli come, impulses can be set up only so often. After firing, a nerve fiber cannot fire again for a brief interval, even in response to strong stimuli. This period of complete irresponsiveness, approximately one thousandth of a second long, is called the *absolutely refractory period*. It is followed by a *relatively refractory period*, during which a very strong stimulus is needed to produce a new impulse in the nerve fiber. Refractoriness limits the frequency with which a nerve cell can fire and constitutes an inborn defense against nerve fatigue. The common expression "tired nerves" is thus not a proper psychological or medical term. Following the refractory periods and before the resting level is regained, supernormal and subnormal excitability levels may occur. After firing, a nerve cell usually will regain its normal excitability in about a ten thousandth of a second.

4. A weak battery attached to a wire will produce a small current in the wire; a strong battery, a larger current. But nerve impulses do not vary in size according to the strength of the stimulus. If an axon responds, it responds in full. A small electric shock gives no impulse; increase the shock step by step, still no impulse. Then, suddenly, a small increase produces a nerve impulse which is fully as large as if the shock were many times stronger. This is the *all-or-none principle*. Each fiber has a *threshold* below which it is unexcitable; all stimulus strengths above the threshold produce a full response. The size of the response may vary somewhat with the condition of the axon at the moment but not with the strength of the stimulus. For example, an impulse set up in the relatively refractory period of the preceding impulse is reduced in size.

This all-or-nothing characteristic raises an interesting question, for we all know from experi-

ence that our sensations *do* vary in strength. There is a double explanation for this. First, as we have just seen, fibers differ in their thresholds; thus in a whole nerve the response will be greater for a strong stimulus since it will exceed the threshold of more axons making up the nerve. Second, the frequency of discharge increases logarithmically in proportion to the intensity of the physical stimulus acting on the receptor (Ruch and Patton, 1965). As a result of this mechanism, more impulses will be sent in a given period of time. Thus the strength of the sensation varies with the frequency at which axons send impulses and with the number of axons involved, even though the strength of each axon's responses remains constant.

Nerve impulse conduction can also be likened to a chain of fire sweeping along the fuse of a firecracker; the stimulus is like a match. The nerve impulse, like fire traveling along a fuse, needs little energy to start, has energy for conduction supplied all the way along, and, if its destination is a muscle, releases a great deal of energy when it reaches it. This is unlike the conduction of electrical, light, or sound waves, where the energy that emerges at the far end is only the energy put in at the beginning, minus what has been lost along the way.

The analogy of the fuse is not completely accurate, however. For one thing, the nerve is self-restoring whereas a fuse is not. And the actual transmission of energy is somewhat different. In a fuse it is a simple chemical (oxidative) process whereby each segment excites the next by heating it up to the flash point. In the nerve it is an electrochemical process: the energy comes from slow oxidation (metabolism) and is stored up by a charging of the outer film or membrane of the nerve like the plates of a condenser. Thus the inside and outside at each point along the nerve are like the two poles of a battery; that is, the membrane is polarized. If the stimulus breaks down the resistance at any point, there is a loss or reversal of polarization, and the next segment of the nerve, acting like a battery, discharges through the low resistance and changes its own polarization. This causes the resistance to break down at the next point, and so on along the nerve. During the relatively refractory period, the resistance is restored and the "battery" is recharged.

Although the nerve impulse is not like an electric current passing along a wire, the movement of the impulse does give rise to measurable local flow of electric currents, which physiologists use in studying the nervous system. The general procedure is to attach to a nerve the two electrodes of an amplifying system comparable to that in a radio. The tiny electric currents set up by the impulse are recorded by means of a cathode ray oscilloscope, an instrument in which a beam of electrons is deflected by an electromagnetic field and displayed on a fluorescent screen. The beam is deflected vertically by the potential differences that cause the

flow of current in the axon, and horizontally at a predetermined speed. This shows the time course of the action potential of the nerve impulse. Because an electric potential change rather than a current is measured, one speaks of the "action potential" of the nerve impulse.

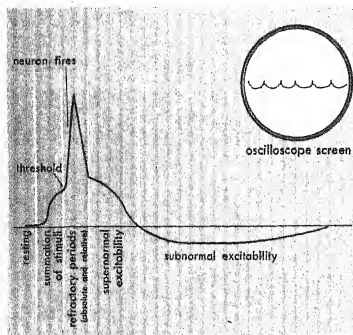
The synapse. Nerve cells do not join each other physically as do lengths of pipe. Each branch of an end brush of one neuron terminates in a *synaptic knob*, a rounded expansion applied against the dendrites or cell body of the next neuron, but there is no protoplasmic bridge between two cell walls. This type of close association without continuity is called the *synapse*. Synapses throughout the nervous system take many forms but always it is a case of "contiguity without continuity." As the nerve impulses pass across a synapse between two neurons, there is a lag in their rate of travel. Some impulses never cross the synapse at all. Both these facts are indicative of a discontinuity at the synapse.

Perhaps the main advantage of the discontinuity furnished by the synapse is that it allows impulses from converging neurons to interact with one another.

The synapse serves as a one-way valve. Although nerve impulses will travel in both directions along axons, they cross the synapse only from end brush to dendrites or cell body—never in the opposite direction.

The way a nerve impulse "jumps" from one neuron to another across the synapse has been under study for many years. When a nerve impulse reaches a synaptic knob there is a potential change in the membrane of the next neuron. This change in potential is quite different from the nerve impulse itself. It does not obey the all-or-none law, and when it reaches a certain size (threshold), it causes an impulse to be set up in the second neuron. It is therefore called the *excitatory postsynaptic potential* or EPSP. The EPSP's from two presynaptic impulses can combine their effects, thus increasing the likelihood that a nerve impulse will start in the second neuron.

The synaptic knobs of some axons are capable of initiating a different kind of potential change in the membrane of the next neuron: a so-called *inhibitory postsynaptic potential*



▲ CHANGES IN ACTION POTENTIALS

An oscilloscope records the changes in potential before, during, and after an axon fires. The membrane along the outside of the axon is polarized during the resting state, with the outside positive and the inside negative. When stimulation reaches the threshold for the nerve impulse, there is a sudden reversal in polarization as positive ions rush through to the inside, making it positive relative to the outside. A mechanism not yet understood promptly forces them back out, restoring the original polarization. Parallel to the sudden spike in the recording and the following changes in the potential of the axon are corresponding changes in its excitability, as shown in the illustration.

(IPSP). An IPSP, when present, impedes or even inhibits the development of a nerve impulse. It does this by suppressing the EPSP which is necessary for initiating the all-or-none impulse. This is an important point since the patterned integration of neural activity requires some mechanism capable of stopping, as well as starting, nerve impulses.

It is believed that a chemical substance passes across the synaptic space from the synap-

tic knob to the underlying membrane, which it depolarizes. In fact, with the electron microscope there can be seen small vesicles believed to contain a transmitter substance which is released into the space between two neurons. One such substance may be acetylcholine, as at the junction between a nerve and a muscle fiber, but it is thought that a variety of transmitter substances may be involved in different systems in the brain.

REFLEX ACTION

We shall begin our discussion of neural functioning with the relatively simple types of behavior that involve structures in the spinal cord, saving the discussion of the behavior brought about through the mediation of the higher brain centers for later pages. Sensory-motor behavior uninfluenced by centers of correlation in the brain is called spinal reflex action. Such action has been carefully studied in animals whose brains have been separated from their spinal cords, leaving the cords intact. Many principles established for spinal reflex action will be found to hold for responses involving the higher centers as well.

The Distributing System of the Spinal Cord

A two-neuron reflex arc can cause a purely local response. Such arcs originate mainly in muscle and cause a response in that muscle. They provide the reflex basis of posture. No extensive distributing system is needed. On the other hand, if we pinch a baby's finger, the whole arm is drawn away. Here a localized stimulus results in the activation of muscles over a much larger area as a result of the distributing system of the spinal cord.

The first stage in this distributing system is provided by the afferent neuron itself. On entering the spinal cord, it divides into ascending

and descending branches, giving off collaterals at each level of the spinal cord. Each of these collaterals, in turn, can connect with an interneuron which runs up and down the cord, at each level giving off collaterals to motoneurons. In general, afferent neurons run in the *dorsal* (back) column of the spinal cord and efferent neurons in the *ventral* (front) column. Interneurons and the terminations of collaterals that synapse with them are found in the gray matter in the center of the cord. Through the distributing mechanisms just mentioned, impulses from a single afferent neuron can innervate many different muscles, producing large-scale reflex responses. This type of distribution is called *divergence*.

A reverse consequence of this arrangement is called *convergence*. Obviously, impulses from many afferent neurons can ultimately reach the same motoneuron, the system acting much like a funnel. Convergence makes it possible for the same muscle fiber to take part in many different reflexes, and functions in the mechanism of summation described on page 52.

Another function of the distributing system of collaterals and interneurons is the prolongation of excitation. This occurs because they are arranged in *self-exciting circuits* of interneurons. In such circuits, when one neuron discharges, the nerve impulse passes down the main axon and also into a collateral branching

◆ SELF-EXCITING CIRCUITS

Through circular connections like those shown in this simplified diagram, an impulse may be prolonged in the nervous system and the same stimulation may result in several successive messages to the effectors.



off from it. This branch may connect with a second neuron, causing it to be excited. The axon of the second neuron, in turn, transmits the impulse to the original cell and excites it a second time. This may be repeated many times. Each time around the circuit, an impulse goes to the motoneuron and muscle, like a spark from a grindstone. ♦ Thus a momentary stimulus can cause a response which continues long after the stimulus has been withdrawn. Such a response is not possible where only a two-neuron arc is involved. Many psychologists and neural physiologists are confident that eventually the process of thinking will be explained in terms of self-exciting circuits in the brain.

In the intact animal, interneurons in the spinal cord and collaterals from incoming afferent neurons serve still another function, forming long circuits which carry impulses to the brain. These keep "headquarters" informed of what is going on, and the brain may then modify the activity of the simpler reflex arcs.

Thus the distributing system of the spinal cord does four things: (1) enables impulses from a single receptor to reach many muscles (divergence), (2) permits the same muscle to be used in reflexes initiated by stimulation from many points on the skin (convergence), (3) extends a response in time, and (4) causes impulses to be long-circuited to the brain. ■

The Adaptive Nature of Reflexes

Reflexes usually perform some muscular or glandular response which is obviously of service to the organism. Withdrawal of a limb when it is injured protects it from further injury and is therefore termed a *protective reflex*. Tears induced by a fleck of dust wash it out of the eye. Some reflexes are necessary to vital functions of the body; these include reflexes which regulate the beat of the heart or the diameter of blood vessels.

In contrast with the protective reflexes are the *postural reflexes* which underlie standing and holding the head upright. For example, if someone jumps on your back your knees buckle momentarily and then your legs extend, restoring the original posture. The bending of your knees stretches a *muscle spindle*, a group of muscle fibers wrapped with both afferent and efferent nerve endings. The stretching of this spindle by the bending of your knees stimulates the afferent nerve endings, sending impulses to the spinal cord. Here they pass directly to the motoneuron that supplies the ordinary muscle fibers adjacent to those from which the message came. The stretched muscle contracts and your balance is restored. This reflex is called the *stretch reflex* because its stimulus is the stretching of the muscle spindle. ♦ Afferent neurons involved in postural reflexes such as this are the largest and the fastest-conducting, perhaps because continuous maintenance of posture is even more important to the individual than are the rapid protective reflexes.

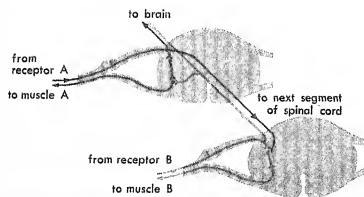
Localized reflexes. Most of the simple protective reflexes involve action at the part of the body where stimulation occurs. When one leg is pinched, for example, it is that leg which is withdrawn. In the course of evolution apparently those organisms survived which were best equipped with localized reflexes programed by heredity to protect the body from injury and to maintain posture.

Irradiation. If the strength of the stimulus is increased, the number of muscles coming into play is increased. Lightly scratch the sole of a baby's foot, and the toes alone will move; pinch the foot and the whole leg will be sharply re-

tracted; a stronger pinch may produce a response of the entire body. As more sensory fibers are activated, more interneurons come into play, leading to stimulation of more motoneurons.

Latent period. Even the simplest reflexes do not occur instantaneously. The delay between the presentation of the stimulus and the beginning of a response is made up of the time required for the sensory nerve ending to be aroused and for the impulse to be conducted through the nerves involved, plus the time that is lost at the synapse or synapses and the time required for the responding muscles to begin contracting. The more synapses involved, the longer this period will be. But reflex actions on the whole are very quick—much quicker than voluntary actions. In fact, protective reflexes are frequently performed so quickly that the adaptive movement is complete before one becomes aware of the stimulation. The spinal reflex with the shortest latent period of all is the stretch reflex, which has already been described.

Afterdischarge. A stimulus lasting a fraction of a second often causes the motoneurons to

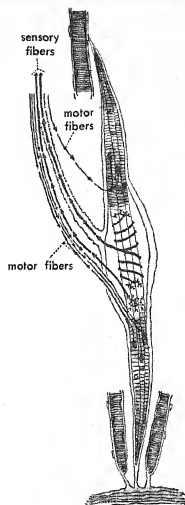


THE DISTRIBUTING SYSTEM OF THE SPINAL CORD

This is a highly diagrammatic representation of the distributing system of the spinal cord. Stimulation of one receptor can lead to action in several effectors (divergence), and messages from several receptors can reach a single effector (convergence). Through this distributing system, the messages can also be long-circuited to the brain.

A MUSCLE SPINDLE

There are two sets of nerve endings in a muscle spindle—sensory endings near the center and motor endings near both ends. Stimulation of the sensory endings by the stretching of the muscle restores erect posture by bringing about a reflex contraction of adjacent muscle fibers. The function of the motor fibers to the spindle itself is to contract the ends, thus making the central part taut, an optimal condition for sensitivity to stimulation.



discharge for several seconds or even minutes. This happens, as we have seen, because impulses traveling through long-circuit chains and self-exciting circuits continue to reach the motoneurons long after those which took the shortest path. The stretch reflex has no after-discharge whatsoever. One volley of afferent impulses yields brief contraction. But we can stand for hours, because the muscle spindle keeps sending new impulses as long as it is stretched.

Summation. If a very weak stimulus is repeated, the reflex response may eventually take place even though a single presentation of the same stimulus is ineffective. Although the few afferent fibers excited by a weak stimulus are unable to excite even one motoneuron, repetition brings a summation of effect which causes a reflex response. This is known as *temporal summation*.

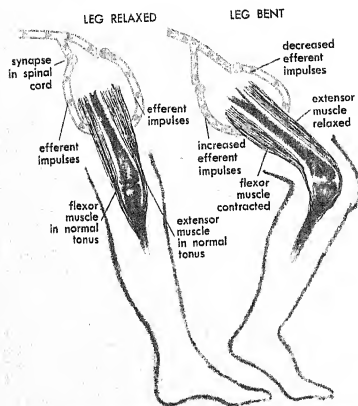
Summation also may occur when two different but adjacent points on the skin are stimulated. Even though each stimulus alone causes no reflex response, a reflex act may take place when the two points are stimulated at the same time. This is called *spatial summation* be-

cause different points, and hence different afferent nerve fibers, are involved. Spatial summation is evidence that the interneurons collect the impulses from many afferent fibers to excite a single outgoing fiber.

A third type is the summation of impulses from higher centers with those of a local reflex arc. For example, in the healthy human being—asleep or awake—there occurs a continual bombardment of lower spinal centers by the motor area of the brain, through the neurons of the pyramidal tract. One effect of this bombardment is to enhance the strength of the *abdominal reflex*. This reflex, which consists of contractions of the abdominal muscles about the navel, can be elicited by running a pin across the skin of the abdomen in a downward direction. The neurosurgeon uses this reflex to test the functional integrity of the descending tracts and the motor cortex above. If summation is absent this reflex is reduced—telling him that there is trouble in the system above.

Postural reflexes are subject to inhibition and summation by nerve impulses from different levels of the brain stem and cerebrum; thus the neurologist can test them to diagnose the location of an injury to the brain. He stretches muscles by tapping their tendons or checks resistance by bending or extending a joint, exciting the stretch reflex.

It is the synapses and the interneurons, of course, which make possible the mechanisms of summation. If the reflex arcs were isolated from one another, they could not affect each other at all.



▲ RECIPROCAL INNERVATION

The flexor muscle enables you to bend your knee, the extensor muscle to straighten it. Normally, a constant stream of moderate efferent stimulation to both the flexor and the extensor muscle insures tonus in both muscles adequate to maintain the leg in the desired position. (In a paralyzed person this tonus is lacking.) When you want to bend or straighten your leg, however, extra innervation goes to the appropriate muscle and innervation of the other muscle is inhibited. Inhibition occurs in the spinal cord, not at the junction of the nerves and muscles.

Inhibition and Reciprocal Innervation

In general, the muscles of the body are arranged opposite one another in antagonistic pairs, one extending and the other flexing (bending) a given joint. When one muscle contracts, its antagonist relaxes, for the *excitation* of one is accompanied by the *inhibition* of the motoneurons supplying the other. This is known as the *law of reciprocal innervation*. ▲ Were it not for this mechanism, antagonistic muscles would be trying to do different things at the same time, and the tug-of-war might result in no movement at all

being accomplished. Reciprocal innervation permits an arm or a leg to do one main thing at a time.

Inhibition (p. 48) occurs only at synapses. It is not the muscle fibers themselves that are inhibited, but the motoneurons leading to them. Whenever a skeletal muscle is not excited, it relaxes.

How does the nervous system decide which message will be inhibited when there is conflicting stimulation? Three characteristics of the stimulus give advantage to one over another in the competition for dominance in the organism's activity.

1. Painful stimuli usually have the right of way. The organism is innately organized (or "programed," as the computer technologists say) to let the important business of self-protection come first.

2. Strong stimuli or repeated weak stimuli have the right of way.

3. Too frequent repetition of a response will give the right of way to a rival response, partly because of fatigue and partly because of adaptation. That is, if a stimulus is repeated continually, the organism ceases to respond to it. For example, a peculiar odor in a room seems to disappear after you have been there a while.

THE BRAIN—"THE GREAT RAVELLED KNOT"

In the human brain billions of nerve cells are woven together. Each of these can send messages to near or distant cells by means of complex interconnections. A near infinity of neural patterns in the brain provides for each of the near infinity of human feelings, thoughts, and actions. The biggest electronic computer runs a very poor second to the human brain.

In the last analysis, the superiority of man over lower animals derives from his superior ability to act, think, and plan, utilizing objects both present and absent in solving problems and overcoming the difficulties imposed upon him by his environment. This ability is made possible by his brain, which operates with an intricate division of labor and with much more control over the rest of the nervous system than we find in any of the lower animals. This "great ravelled knot," as the brain was called by Sir Charles Sherrington, the eminent British pioneer in neurophysiology, is the master tissue of the human body, and its study is the most challenging of the biological sciences.

How Scientists Study the Brain

There are several recognized methods of studying the functioning of the various parts of

the brain. The five most important ones are the anatomical method, the method of extirpation, the action-potential method, the method of stimulation, and chemical methods.

The anatomical method. After an organism dies, its tissues can be treated in such a way that nerve pathways can be traced under the microscope. By this method the anatomist early learned what sense organs sent fibers where and what parts of the brain sent motor fibers to the spinal cord. The anatomist has seen hundreds of connections for which the physiologist has not yet been able to figure out a purpose. It is as though a jungle native were given a television set: he could see where the wires went, but it would be a long time before he could understand the functions of condensers, transistors, and the various circuits.

The method of extirpation. To *extirpate* means to cut out or destroy. The behavioral scientist uses the method of systematic destruction in studying the brains of living animals. First, the behavior of an animal is carefully observed and measured. Next, the scientist cuts away part of the brain and observes how the behavior is changed. Experimental operations of

this type can be performed on animals, but with man such observations are possible, of course, only when disease, accidents, or combat wounds have destroyed parts of the nervous system. In such cases, the parts destroyed are seldom sharply localized; thus observation generally leads to less clear results than can be derived from cases involving deliberate, carefully placed injuries to the brain of an animal. Injuries to the brain, whether the result of experimental destruction or of an accident, are referred to as *lesions*.

When a certain bit of behavior disappears or becomes exaggerated or modified after the loss of a portion of the nervous system, the neurologist concludes that that portion of the nervous system is essential to normal performance of the behavior in question. Such observations do not imply that the area destroyed has the sole responsibility for that behavior, however.

The action-potential method. We know that neurons produce electric currents when they conduct and that the potentials underlying them can be recorded with a cathode-ray oscilloscope. When a barrage of impulses is fired over a sensory pathway, the "bull's-eye" in the brain can be determined by recording changes in the electrical potentials in the cerebral cortex. In fact, workers at the University of Washington have developed a technique for studying the impulse in a single cortical neuron (Amassian, 1953). By correlating the areas of greatest electrical activity with the nature of the stimulus at a given moment we can determine which areas of the brain are involved in various types of sensations and how, for example, the body surface or the retina is represented on surfaces in the brain.

The method of stimulation. The areas of the brain necessary to sensation can be mapped by stimulating the brains of patients during surgical operations and obtaining introspective reports on the sensations they experience. Areas related to muscular activity can be mapped by stimulating different parts of the brain and watching to see which parts of the body move. In this way the experimenter can correlate exact spots in the brain with particular muscle groups.

A refinement of the stimulation method is to stimulate some part of the brain of a conscious animal through electrodes fixed in that area. Deep nuclei or pathways can be reached for stimulation through a stiff wire positioned by a rack-and-pinion device clamped to the head. As we shall see in later chapters, in some experiments the animal itself controls the stimulation.

Chemical methods. It is possible with advanced surgical techniques to apply various chemicals to selected areas within or on the surface of the brain. For example, a strong salt solution has been used to stimulate nerves deep within the body. More recently, such techniques have been improved to the point that tiny tubes (*canulae*) can be inserted with precision into specific nuclei deep in the brain as passageways for minute amounts of chemical crystals. Finding which of these crystals activate particular nuclei gives a clue as to the type of transmitter substance employed in the synapses there (Grossman, 1960).

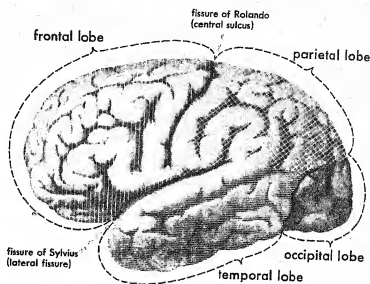
Chemical substances such as procaine serve as local anesthetics, producing temporary effects similar to those produced by destruction. The advantages of "temporary destruction" when experimenting on healthy living individuals are obvious. Changes in the chemical composition of brain regions, even of single neurons, can now be studied to learn the chemical aspects of nervous activity.

Main Parts of the Brain

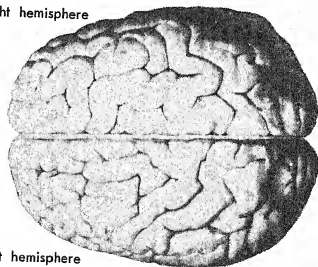
The main part of the brain—the *cerebrum*—is divided into two halves: the right and left *hemispheres*. When seen from above, it looks something like a shelled walnut. In general, the *left* hemisphere controls the *right* side of the body and receives impulses from the right side of the body and of the external world; the *right* hemisphere controls the *left* side and receives impulses from it. One hemisphere is essentially a mirror image of the other. Each hemisphere has two deep grooves, known as the *fissure of Rolando*, or *central sulcus*, and the *fissure of Sylvius*, or *lateral fissure*, in addition to many smaller grooves formed by the convo-

THE HUMAN BRAIN

The pictures at the right show the intact human brain as viewed from the left and from above. The main lobes and fissures are labeled in the upper view. Directly below is a view showing a cross section of the front part of the brain where the two hemispheres are not yet linked by the corpus callosum. It shows how much the cortex is increased by the formation of convolutions around the edge. In general, the higher the species, the more convolutions there are and the deeper they become. The intelligence of the species (but not of the individual) is directly related to the degree of development of the cerebral hemispheres and particularly of the cerebral cortex.



right hemisphere



left hemisphere

lutions of the surface. There are four sections, or lobes, in each hemisphere:

1. The *frontal lobe*, located in front of the nearly vertical fissure of Rolando and above the fissure of Sylvius.

2. The *parietal lobe*, still above the fissure of Sylvius but back of the fissure of Rolando.

3. The *temporal lobe*, below the fissure of Sylvius, lying just inside the temples.

4. The *occipital lobe*, located at the back of the brain. The lobes of the left hemisphere are shown in the bottom diagram.

If we examine a cross section of the brain with the naked eye, we see that there is a nar-

row, grayish rind of tissue covering the cerebrum. This is the *cortex* (which means "bark"). It is made up largely of the dendrites and cell bodies of neurons whose axons extend into the interior part of the hemisphere.

Examining the center of the cross section, we find that it comprises by far the larger portion of the brain. It is almost white in color, the whiteness resulting from the presence of the white myelin sheaths of countless nerve fibers. Studies have shown that these fibers are of several different sorts. Some are sensory fibers coming up from the spinal cord by way of relay centers in the older parts of the brain; some are

motor fibers going down to the spinal cord; others connect one area of the cortex with another area of the same hemisphere, with areas on the opposite side of the brain, or with a variety of separate structures beneath the cerebrum.

The structures located underneath the cerebrum can best be seen in a midline view obtained by cutting through the middle of the brain from the front to the back. • The term *brain stem* is used to designate all the structures that lie between the cerebrum and the spinal cord. The centers in this region which are of particular interest in the study of psychology are the thalamus, the hypothalamus, the reticular formation, and the rhinencephalon.

The *thalamus*, as shown in the diagram, is in almost the exact center of the human brain. It is an important relay station for incoming sensory messages from all parts of the body. Some of the thalamic nuclei which send fibers to the cortex, however, do not receive sensory information. They may serve some more complex integrative function, but this is not well understood as yet. Directly below the thalamus and merging into it is the *hypothalamus*, in which are located important centers for the regulation of metabolism, body temperature, hunger, thirst, and emotional behavior. The role played by the hypothalamus in motivation and emotion will be discussed in Chapters 11 and 12.

The *reticular formation* is a tangled mass of nuclei and fibers in the brain stem just above the spinal cord. The reticular formation has two important functions. Through fibers going down to it from the various higher centers, it suppresses some incoming messages and facilitates others in a manner which will be described in Chapter 9. Through fibers going upward from it to all the higher centers, it acts as a general arousal system: stimulation in this area causes a sleeping animal to wake up and one already awake to become more alert. Some of the nerve fibers serving this arousal function reach higher brain centers directly, while others first synapse in certain thalamic nuclei (the thalamic reticular system).

Much of the normal stimulation of the reticular formation comes from collaterals running into it from the sensory pathways as they go by

it on their way to relay points in the thalamus and subsequent projection on the appropriate sensory area of the cortex. In addition, it is thought that some sensory fibers project exclusively to the reticular formation. Thus a particular stimulus—a prick to the finger, for example—not only gives rise to the specific sensation of pain in the finger but also, through the reticular system, arouses the organism to greater general alertness. It also appears that impulses originating in a specific part of the reticular formation can inhibit activity in some brain structures, reducing arousal and even inducing sleep (Battini, Maruzzi, Palestini, Rossi, and Zanchetti, 1959).

The *rhinencephalon* is composed of a number of complexly arranged nuclei and interconnecting pathways located within the core of the cerebral hemispheres and on their undersurfaces. Because the olfactory pathways so prominently invade the rhinencephalon, it was once believed that it served only the sense of smell—hence the name *rhinencephalon*, or “nose-brain.” As we shall see in Chapter 12, however, it is now known to be concerned in part with various types of primitive emotional states. Moreover, certain rhinencephalic nuclei appear to be responsible for helping to initiate or suppress behavior in adapting to shifting environmental demands; while this is a complicated matter, it is receiving increasing attention (McCleary, 1966). Finally, one structure in the rhinencephalon, the *hippocampus*, is thought to play a role in providing us with recent or short-term memory (see p. 201). The hippocampus in man is a banana-shaped structure that runs through the interior of the temporal lobe.

Historically, the study of these lower brain centers in man has been neglected, partly because of the greater accessibility of the structures nearer the surface of the brain and partly because it was largely assumed that most of their importance had been lost with the development of the higher centers. For example, it was early found that whereas a cat deprived of its cerebrum would still react to visual stimuli—supposedly through thalamic function—a man so deprived would be totally blind. Such findings led to the unwarranted generalization that the role of the lower centers in human sen-

sation could be more or less disregarded. With the methods of chemical and electrical stimulation which are now available, however, there has been a great surge of research on the lower centers and a realization that in man, as in the lower animals, they play an extremely important role (McCleary and Moore, 1965). Although in some cases the newer, higher centers have taken over functions formerly performed by the older parts, it is more common, as we shall see, to find that the older centers have continued to perform their primitive functions with varying degrees of control by the higher centers.

Localization of Function in the Cerebrum

For a long time a controversy raged between investigators who contended that each part of the cerebrum had a definite function which it alone could perform, and those who held that the parts were more or less interchangeable

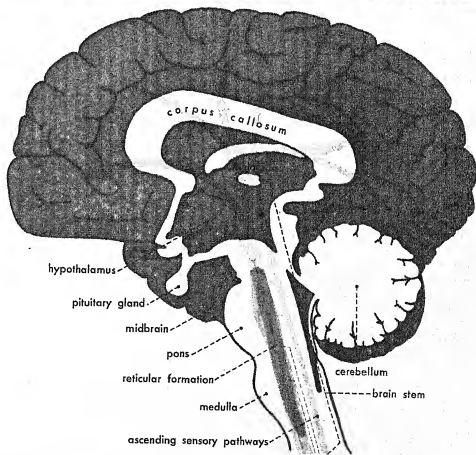
functionally. A compromise position now seems to be the most tenable one.

One early approach to the problem of localizing the higher centers utilized the extirpation method. Monkeys and other animals were trained to perform certain tasks, such as opening a puzzle box or running a maze. After the habit was well learned, portions of the brain were surgically removed and the animals were retested to see how much the habit had been impaired and how well they could relearn it.

Such experiments showed that in the case of some (but not all) habits, the removal of certain parts of the cortex abolished the habit, which could then be relearned. If localization of such functions were hard and fast, the habits would have been permanently abolished. But complete localization did not seem to exist, especially in the rat. Loss of cortical tissue did slow up learning, but the loss in learning ability seemed to be dependent upon the *amount* rather than the *location* of the cortical tissue removed. It is not hard to find a probable expla-

MIDLINE VIEW OF THE BRAIN

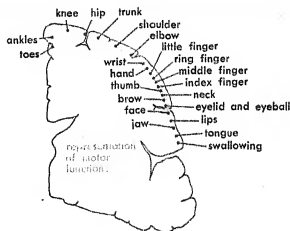
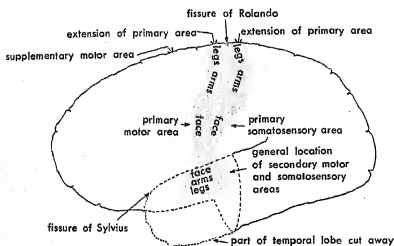
In this view, the brain has been cut through the middle from front to back. The front and upper parts thus show surfaces of the right hemisphere, whereas the various structures below (shown here in white) are all cut areas. The corpus callosum is a huge bundle of white myelinated fibers crossing from one hemisphere to the other, here cut crosswise through the exact center. Below it are subcortical structures. A highly diagrammatic representation of the ascending reticular system is shown in red. Sensory neurons coming up through the brain stem feed part, or in a few cases all, of their input into the reticular formation, through it producing general arousal in all parts of the cerebrum. If the reticular formation is severed at the top, the individual cannot be aroused from sleep.



MOTOR AND SOMATOSENSORY AREAS OF THE BRAIN

The primary motor and somatosensory areas of the cortex lie along the fissure of Rolando; the motor area just in front of it, the somatosensory area just behind it. Corresponding parts of the body are represented by points roughly across the fissure from each other, and representation is upside down; that is, the legs and feet are represented at the top and around the inner surface between the hemispheres, hands and arms are below them, and the head at the bottom. The greater precision of sensitivity and control in head and hands than in other parts of the body is reflected in larger areas of representation on the cortex. Note, for example, that specific areas can be identified for each of the fingers. The face and mouth are also represented in considerable detail.

In addition to these primary motor and somatosensory areas, secondary, largely overlapping motor and somatosensory areas below the first have been found; here the representation of face, arms, and legs is rightside up. Whereas the primary areas represent largely the opposite side of the body, the secondary areas have many connections with sensory and motor endings on the same side of the body. Supplementary motor areas have also been found along the upper, inner surfaces between the cerebral hemispheres; here, as in the secondary areas, there is some mingling of sensory and motor function.



nation for this. Ordinarily many sensory cues are available to guide the rat through the maze—more, indeed, than the rat needs. The removal of a part of the brain may destroy certain of these sensory elements but not others (Lashley, 1929). In the case of certain purely visual habits, at least, another explanation can be offered (Thompson, 1963). Following removal of the higher centers involved in vision, a previously trained rat can no longer perform well on visual tasks it once knew, but it can relearn simpler ones in a normal way. In such cases, it is now known that the rat is using a subcortical nucleus located in the back of the thalamus.

Sensory functions. Over a hundred years ago,

Johannes Müller put forth the doctrine of "specific nerve energies." According to this doctrine, a sensory nerve will produce a certain type of experience no matter how it is stimulated. Close your eyes and press upon the lids. In a moment you will see a wealth of color and design, yet the stimulus is not light but pressure. When the cut ends of the nerve in the healing stump of an amputated leg are stretched, the patient sometimes reports sensations of pain, itching, or even movement in the toes that are no longer a part of his body. If a person is struck on the back of the head over the visual area of the brain, he "sees stars"; that is, the sensations which are produced are appropriate to the function of the particular nerve cells

brought into action (visual), rather than to the stimulus (sudden physical pressure).

But though stimulation of different sensory nerves gives rise to different kinds of sensation, this is not because the impulses are different. As we already have seen, nerve impulses differ only in amplitude and rate of propagation. The specificity seems to lie in the *kind of neurons* located in the part of the brain where a particular sensory track ends.

Several specialized regions in the brain have been found to have specific motor or somato-sensory (body sensitivity) functions. These areas are shown in the illustration. The brain centers involved in the special senses will be discussed in Chapter 8.

Motor functions. Three areas of the brain have been found to be involved in controlling body movements. The *primary motor area* is concentrated immediately in front of the fissure of Rolando but extends both forward and backward. The body surface is "projected" onto this area in a manner that has been likened to the projection of a lantern slide onto a screen. The feet are represented at the upper part of the motor area, the trunk farther down, and the hands still farther down; the face and tongue are localized at the bottom. The body is thus represented upside down.

Long axons lead down from this area of the brain through the spinal cord to the motoneurons supplying the muscles of the body and the extremities. When a part of this brain area is stimulated, some voluntary-muscle group responds, and when areas in this region of the brain are destroyed, movement is impaired accordingly.

A second projection of the body's muscles has been located near the fissure of Sylvius. Little is known of the function of this *secondary motor area*. Still a third representation of the body is found in the *supplementary motor area*, located in the longitudinal fissure near the midline of the brain. These parts of the brain are involved not only with movement but also with the control of posture and of the tension of muscles (muscle tone). The secondary and supplementary areas do not send long axons to the spinal cord. They send short axons to nuclei in the interior of the cerebral hemispheres from

which other short axons go to nuclei in the brain stem; a chain of such neurons leads down to the spinal cord.

Long thought to be concerned only with posture, this short neuron system is now suspected of playing a major role in the control of movement. Certainly uncontrolled, disorderly movements (trembling, jerking, etc.) are caused by damage to certain parts of it and can be cured by surgically destroying others. The long axon system, often described as the motor system *par excellence*, is currently being discounted and even suspected of working not by activating motoneurons but by inhibiting afferent impulses. It is even conceivable that this classic motor system is of equal or greater significance in sensation. Why, for example, do many of its long descending fibers end in the first synaptic station of the incoming sensory system? In this area we appear to be on the threshold of one of those major redefinitions by which science often advances.

Association functions. If we make a drawing of the cerebral cortex and mark off the areas now known to be involved in motor and sensory functions, we find that by far the larger portion is not touched by our pencil. These parts are not unused, however. They are the *association areas*, so named because it was originally assumed that it must be here that new "associations"—that is, learning—took place. Although much remains to be learned about these areas, it is now recognized that this is far too simplified a picture. Studies of the possible mechanisms involved in learning will be discussed in Chapter 6.

The association areas of each side of the cerebral cortex are connected with each other, with motor and sensory areas, with similar areas on the opposite side, and with the thalamus. They serve to correlate and integrate the simpler functions of the sensory and motor areas. In fact, the sensory areas act essentially as gateways into the cortex, and the motor area as the exit. Thus injuries to the cortex outside but near the visual area do not cause blindness but destroy awareness of depth and recognition of visual objects. Surprisingly, not all of the association areas are adjacent to the particular sensory and motor areas they serve. Some of them

as we shall see in Chapter 6, are located at distant points in the brain. The association cortex seems to work as a whole, and impairment of function as a result of damage to it is likely to be more related to the extent of the damage than to the exact placement of it. *

Study of the speech functions of the association areas began in the last century. Although much is now known of the relationship between damage to association areas and defects in speech and understanding of words, there is still much to be learned before discordant theories are reconciled.

In 1861 Paul Broca reported the classic case of a patient who showed an almost complete loss of speech ability. Careful examination of the patient's brain showed that an area in the

frontal lobe of the left cerebral hemisphere just above the fissure of Sylvius had been destroyed. This area, which is near the area controlling the mouth, has come to be known as *Broca's area*. About ten years later Carl Wernicke discovered that destruction of the cortex of the left temporal lobe below the auditory area, extending backward and curving up around the end of the fissure of Sylvius, was associated with inability to understand spoken language. This area has since been called *Wernicke's center*.

Disease or injury to certain association areas brings about an interesting condition in which the person is unable to recognize objects by their "feel." A familiar object like a door key or a pencil can be handled indefinitely and still not be recognized. Patients who show this type of disorder are still capable of experiencing normal elementary sensations; their difficulty is in organizing these elements into normal perceptions.

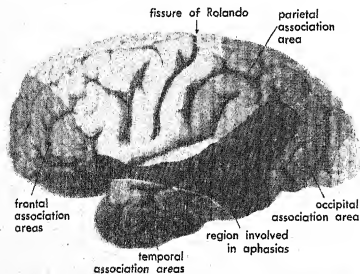
Similar disorders of perception are found in other sensory fields. These disorders are called *agnosias*, or "inabilities to know," and are classified on the basis of the nature of the function which is impaired. Related disorders affecting language are called *aphasias*. Three frequently encountered aphasias and aphasias are:

1. *Astereognosis*. Loss of ability to recognize solid objects through the sense of touch (cutaneous and kinesthetic senses).

2. *Alexia*. Inability to recognize printed words. This is commonly called "word blindness."

3. *Sensory aphasia*. Inability to recognize spoken words. This condition is sometimes called "word deafness," and it can occur in persons who can hear simple sounds. These particular conditions seem to be associated with lesions in the association regions close to sensory areas of the cortex.

Similar impairments of the association region, near the motor areas give rise to motor disturbances, especially of the apparatus used in speech. In some cases the sensory and motor aspects of speech are little affected, yet there are subtle disturbances of speech which are difficult to describe. Aphasia at this level merges into intellectual functions. Speech defects indicative of faulty intellectual processes are often caused by mild but widespread damage

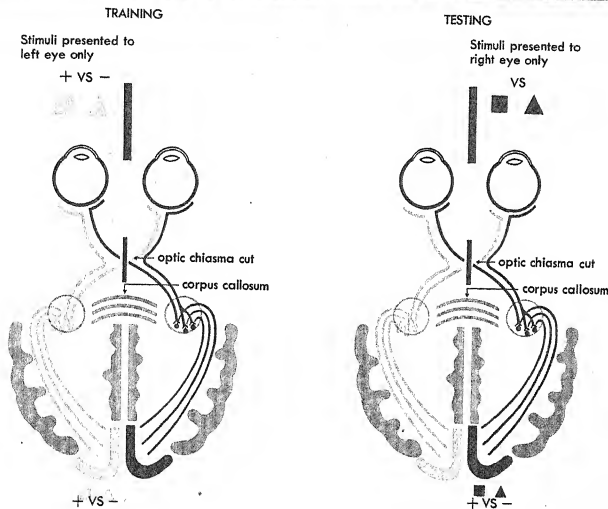


● ASSOCIATION AREAS OF THE BRAIN

This diagram shows the areas of the brain regarded as association areas. Damage to the gray area typically results in some type of disturbance in the understanding or use of spoken or written language, but the line of demarcation between it and the other association areas is not as clear as here indicated. The various association areas evidently are highly interrelated, with the result that separate, specific spots cannot be identified as responsible for specific functions. When these areas are damaged, the impairment in function seems to depend more on the amount of the damage than on the exact place where the damage has occurred.

■ **DIAGRAM OF A SPLIT BRAIN EXPERIMENT**

During the training sessions, the animal saw the stimulus figures with the left eye only and learned to choose the one which was rewarded, indicated above the stimulus figures by a plus. The same symbols under the left occipital lobe indicate successful discrimination during training. In the testing session the same stimulus figures were presented for the first time to the right eye without reward. The animal chose the figure rewarded earlier even though the part of the brain now being stimulated, the right occipital lobe, had received no sensory input during the training session, and the area supposedly involved in the original learning, the left occipital lobe, was not now receiving any sensory stimulation. Only some transfer of learning by way of the corpus callosum seemed to explain these results. Evidence favoring this explanation was found in a later study: when the corpus callosum was severed, transfer did not occur.



to the cerebral cortex rather than disturbance to only one area.

Connection between the hemispheres. Besides the bundles of association fibers connecting areas of the same cerebral hemisphere, a massive bundle of axons—the *corpus callosum*—connects the two hemispheres of the brain. There are also a number of smaller connections lower down, called *commissures*. The corpus

callosum consists of closely packed nerve fibers having cell bodies in one hemisphere and endings in the other. It contains thousands of fibers which fan out from this crossing point to connect points in the cerebral cortex in one hemisphere with the corresponding areas in the other. Until recently, very little was known about the functions of this interhemispheric association system, but much is being learned now from studies of animals with "split brains."

One investigator conceived the notion of teaching one side of the brain to do something—for example, discriminate between visual forms—to see if this learning would be passed to the other half. First, he split the crossing fibers from the eyes of cats and monkeys so that things seen with the left eye could send messages only to the left hemisphere and things seen with the right eye could send messages only to the right hemisphere. Next, with the right eye blindfolded, the subject was presented with two visual forms, a square and a triangle. After the subject had learned to select the square, the same problem was suddenly presented for the first time to the right eye, with the left eye blindfolded. The correct form was selected at once. One half of the brain had evidently taught the other half by way of messages transferred through the corpus callosum.

In animals whose corpus callosum was cut through, however, the transfer of the learned response did not occur (Sperry, 1961).

Subsequent experiments have shown that in animals with split brains two conflicting discriminations can be learned simultaneously. Such learning is impossible for a normal animal, which reacts with signs of intense frustration (Trevarthen, 1962). Ordinarily the two hemispheres function cooperatively, with one assuming dominance (usually the left hemisphere in right-handed people). Each hemisphere, however, evidently has the potentiality for the full complement of perceptual, learning, and other cognitive functions.

There is an important group of biological structures working in close cooperation with the nervous system in adjustive behavior. This is the system of ductless, or *endocrine*, glands. These glands are well supplied with blood vessels but have no ducts through which to channel the substances they produce; instead they pass their secretions directly into the blood stream. The chemical substances secreted by the endocrine glands are called *hormones*; they greatly affect the functioning of the body and the course of its development. The word *hormone* comes from the Greek word meaning "I excite."

The activity of the endocrine glands is regulatory in nature. Their secretions serve to control the individual's *metabolism*—the chemical reactions taking place in all living tissue by which energy is provided to carry on the life processes and by which growth takes place in bones, muscles, and nervous tissue. These glands also help to maintain internal conditions within an optimal range. For example, if there is an oversupply of sugar in the bloodstream, certain endocrine structures release a flow of the hormone *insulin*, which helps the body me-

tabolize the sugar and return the blood to its normal chemical state. This tendency of the body to maintain constant conditions is called *homeostasis*; it involves activity of the nervous system and other physiological mechanisms as well as the endocrine glands.

The endocrine glands play a large role in *coordinating* the activities of the body. In sudden fear, for example, a hormone is circulated through the blood which brings about such widely diverse activities as dilation of the pupil of the eye, constriction of the blood vessels in the wall of the stomach, and an increase in the rapidity with which blood clots in the presence of air. Sex hormones of an animal in heat act on the brain, making it easier to trigger sex behavior.

In helping to maintain equilibrium and coordinate body functions, the various endocrine glands work closely together. If one gland is functioning too slowly, another gland may release a hormone to stimulate its action; if one gland is overactive, another one may secrete a hormone to slow it down. Damage or removal of one endocrine gland may disrupt the functioning of the entire system.

As we shall see in the next chapter, endocrine secretions accelerate, slow down, start, or stop many physiological activities related to maturation. The change of voice in the adolescent boy, for example, is associated with activity of the male sex glands, which begin to secrete their hormones actively at the time of adolescence. Whether an individual reaches physical maturity early or late depends on the combined action of a number of glands in the endocrine system.

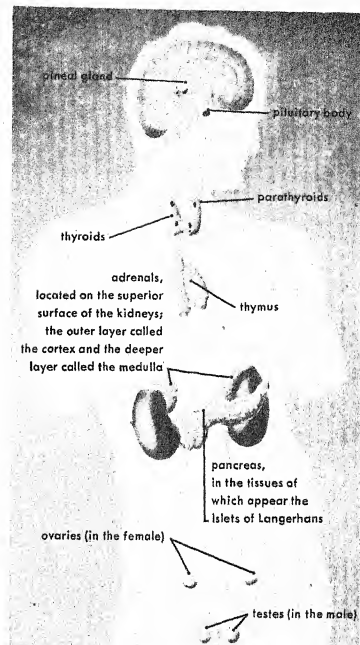
Endocrinology is a comparatively new study in the field of physiology, and the functions of the ductless glands are still only partially understood. We do not have a full list of the hormones, nor do we know all the organs that produce them. But despite the many gaps in our knowledge about the mechanisms of the endocrine system in man, there is abundant evidence of its important role in human adjustment and development.

The master control center for the endocrine system evidently lies in the hypothalamus (Talbot, Sobel, McArthur, and Crawford, 1952). There is evidence that even the nerve cells in the hypothalamus may secrete certain regulatory hormones (Zuckerman, 1957). The locations of the various endocrine glands are shown in the illustration. Those whose functions are of greatest interest to the psychologist are the *pituitary*, the *thyroids*, the *adrenal glands*, and the *gonads*.

The Pituitary

The *pituitary*, a small structure attached to the underside of the brain and located in the center of the head, secretes a number of different hormones which perform various functions concerned with growth and maintenance. Particularly vital to normal bodily development during childhood is the *pituitary growth hormone*, which, as we shall see in Chapter 3, controls the growth of the skeleton, muscles, and various internal organs.

The pituitary also produces a variety of "middle man" hormones which act directly upon other endocrine glands—most notably the thyroids, the sex glands, and the adrenal cortex—to stimulate their functioning. A multitude of fac-



Above are shown the locations of various ductless glands. The pituitary body produces the growth hormone and the "middle man" hormones. The thyroids affect principally metabolism, growth, and the development of intelligence. The parathyroids influence calcium and phosphorus metabolism. The adrenal medulla produces adrenaline and noradrenaline, both important in emotion; the adrenal cortex affects general body activity, secondary sex characteristics, and reactions to prolonged stress. The gonads are vital to sexual development, sexual drive, and reproduction: the ovaries (female) produce estrogen and progesterin and the testes (male) produce androgens. The islets of Langerhans secrete insulin which controls the sugar level in the blood. The thymus plays a key role in building immunity. The functions of the pineal gland are still being investigated.

tors seems to control the secretion of these hormones. The interaction between the pituitary hormone *corticotropin* (ACTH) and the secretions of the adrenal cortex have been shown to be an important factor in rheumatoid arthritis and other physiological disorders. A theoretical explanation of the relationship between endocrine function and certain diseases—the concept of the *general-adaptation-syndrome*—will be discussed in Chapter 12.

The Thyroids

Located in the neck at either side of the "Adam's apple" are the thyroid glands, which produce a hormone called *thyroxin*. Operating in close conjunction with the pituitary, the thyroids affect body metabolism and help to control the rate of physical growth. High thyroid output goes with high general activity and low output goes with sluggishness of movement. Like the pituitary, the thyroids appear to secrete hormones which stimulate the sex glands, although this function is not well understood. Thyroid secretions influence the structure and function of the nervous system, especially in the development of intelligence.

The Adrenal Glands

Located at the upper end of the kidneys are the two adrenal glands, each consisting of two parts: an inner core (the adrenal medulla) and an outer layer (the adrenal cortex). The *adrenal medulla* is directly controlled by the nervous system, which stimulates the gland to secrete its hormones, *adrenaline* and *noradrenaline*, when the individual is under strong emotion. The manner in which the adrenal glands help the individual adjust to emergency situations will be discussed in Chapter 12.

As we shall see in the next chapter, the *adrenal cortex* produces several different hormones that influence maturation.

The Gonads

The sex glands, or *gonads*, have a dual purpose in both sexes: (1) the secretion of sex hor-

mones that influence bodily development and behavior and (2) the production of gametes (sperms or eggs). These functions, which are performed in males by the *testes* and in females by the *ovaries*, will be described in Chapter 3.

CHAPTER SUMMARY

Modern psychologists see man as an *organism* and are concerned with the *adjustive behavior* through which he meets the demands made by his external and internal environment. Man functions as a whole in adjusting, doing one main thing at a time. His organs are classified into two groups: *organs of maintenance* and *organs of adjustment*.

Traditionally psychologists have symbolized the process by which man responds to some stimulus by the formula $S \rightarrow R$. However, partly because of criticism by the Gestalists, most psychologists now prefer the formula $S \rightarrow O \rightarrow R$, in which *O* symbolizes the internal conditions and organizing processes which affect the response. Sensory feedback, which serves as a new stimulus, is also an essential part of most adjustive behavior.

Underlying every human act, simple or complex, are chains of neural structures. The simplest of these are the sensory-motor arcs, consisting of *receptors*, which are sensitive to stimuli; *sensory (afferent)* nerve fibers, which conduct nerve impulses from receptors toward the center; *connectors*, or *interneurons*, which carry the nerve impulses through the central nervous system; *motor (efferent)* nerve fibers, or *motoneurons*, which carry nerve impulses away from the center; and *effectors*, the organs of response which perform the actual adjustive actions.

Each *neuron*, or single nerve cell, has a cell body containing a *nucleus* and having at each end slender fibers—*dendrites* at the receiving end and an *axon* at the other terminating in *end brushes*, or (in motoneurons) *end plates*. Larger axons are encased in a *myelin sheath*. There are two kinds of neurons: the *long-*

conducting ones, which have a long axon, and the *interneurons*, which have many short dendrites and a short axon. The *nerve impulse* which travels along the neurons differs from an electric current in that the nerve impulse is much slower and retains its original strength. Nerve fibers can conduct only several hundred impulses per second and, after firing, are irresponsive during the *absolutely refractory period*, gradually regaining full excitability during the *relatively refractory period*. According to the *all-or-none principle*, a fiber responds fully to any stimulus which is above its threshold. The strength of sensations varies with the frequency at which axons send impulses and the number of axons involved. The impulse gives rise to measurable local flow of electric currents, measured indirectly by changes in its *action potential*. A change in potential occurs when an impulse jumps a *synapse*, a point at which two neurons are closely associated without actually being joined.

The spinal cord functions as a distributing system which: (1) enables impulses from a single receptor to reach many muscles (divergence); (2) permits the same muscle to be used in reflexes initiated by stimulation from many points on the skin (convergence); (3) extends a response in time; and (4) causes impulses to be long-circuited to the brain.

Reflexes, which are adaptive in nature, may be *protective*, usually involving action at the part of the body where stimulation occurs, or *postural*. The latter underlie standing and holding the head upright. By *irradiation* the number of muscles coming into play is increased as more sensory neurons are stimulated. There is a *latent period* for even the simplest reflexes, and *afterdischarge* occurs after the stimulus ceases. Through *temporal* or *spatial summation* the addition of several weak stimuli may eventually bring a response. According to the *law of reciprocal innervation*, the excitation of one of a pair of antagonistic muscles is accompanied by the inhibition of the motoneurons supplying the other. Painful, strong, or repeated weak stimuli usually have the right of way, although too frequent repetition of a response will give the right of way to a rival response.

The amazingly complex brain, which con-

trols much of the rest of the nervous system, is studied by several methods: the *anatomical method*, the method of *extirpation*, the *action-potential method*, the method of *stimulation*, and *chemical methods*. The main part of the brain, the *cerebrum*, is divided into *right and left hemispheres*, each containing two deep grooves—the *fissure of Rolando*, or *central sulcus*, and the *fissure of Sylvius*, or *lateral fissure*—making four lobes—*frontal*, *parietal*, *temporal*, and *occipital*. This part of the brain is covered by the *cortex*, made up largely of dendrites and cell bodies of neurons whose axons extend into the interior section. All the structures between the cerebrum and the spinal cord are termed the *brain stem*. This is the location of the *thalamus*, an important relay station for incoming sensory messages; the *hypothalamus*, which regulates metabolism, body temperature, hunger, thirst, and emotional behavior; the *reticular formation*, which suppresses some incoming messages and facilitates others, acting as a general arousal system; the *rhinencephalon*, involved in primitive emotion and in adjustment to environmental demands; and the *hippocampus*, which may play a role in memory. This lower part of the brain, long neglected, is now recognized as playing an important role in human behavior.

Certain functions are to some extent localized in specific areas of the brain. The *primary motor area* is concentrated immediately in front of the fissure of Rolando but extends both forward and backward. There are also a *secondary motor area* near the fissure of Sylvius and a *supplementary motor area* on the midline of the brain. Areas not concerned with sensory and motor functions are the *association areas*, which correlate and integrate the simpler functions of the sensory and motor areas. Among these are *Broca's area*, injury to which causes loss of speech ability, and *Wernicke's center*, which is associated with ability to understand spoken language. Disorders of perception, *agnosias*, go along with injury to certain associated areas, as do disorders affecting language, *aphasias*. Among these disorders are: *astereognosis*, loss of ability to recognize solid objects through touch; *alexia*, inability to recognize printed words; and sensory *aphasia*, inability to recognize spoken words.

The cerebral hemispheres are connected by a massive bundle of axons, the *corpus callosum*, and by smaller connections called *commissures*. Their function is being studied through the use of animals with *split brains*, which can learn two conflicting discriminations simultaneously, as animals with normal brains cannot.

The *ductless*, or *endocrine*, glands, working in cooperation with the nervous system, play an important part in adjustive behavior. The hormones they secrete control the rate of *metabolism* and aid in the process of *homeostasis*, by which equilibrium is maintained in the body. The master control center for the en-

doctrine system lies in the *hypothalamus*. Perhaps the most important of the endocrine glands is the *pituitary*, because it has the double function of controlling childhood growth and of stimulating other endocrine glands through its *middle-man hormones*. Other endocrine glands include the *thyroids*, which affect metabolism and growth; the *adrenals*, and the *gonads*, or sex glands. The *adrenal medulla* secretes *adrenaline* and *noradrenaline* when the individual is under strong emotion, and the *adrenal cortex* secretes hormones that influence maturation. The gonads produce sperm or egg cells and also influence bodily development.

Part Two How and Why People Differ

"The child is father to the man."
Wordsworth

The poet's view of man holds that we are what we are today because of what we were yesterday and the day before. Psychologists accept this view in part, but they have much more to say about human development.

From the moment of conception, people are "programed" to respond to their environment. When we come into the world we are like all others in many ways but already very different from anyone else in some ways. By the time we reach maturity, all of us share many more characteristics with other members of the human race and particularly with other members of our own culture, but our differences have also increased. One of psychology's major concerns is identifying the factors, past and present, that make us what we are. Without this understanding it can never hope to achieve its goals of predicting and controlling behavior.

The psychologist has come to recognize two great forces in human development—heredity and environment—which always work together in shaping our lives. Each has its role to play, and neither functions independently of the other. Many of the most pressing problems of our society involve the growth or decline of human abilities under the joint influences of heredity and environment. We must educate our children so that each one's unique pattern of capacities will be as fully developed as possible. We must aid mature persons in choosing vocations that will give full scope to their abilities. We

must find a useful place in society for our ever increasing group of elderly people as their capabilities decline. These and many other problems can be solved only after the organization, growth, and decline of human abilities have been carefully studied.

To gather accurate data in its particular area of study, each of the sciences has had to develop suitable measuring instruments. For psychology, this has meant developing appropriate techniques for measuring the various aspects of human personality as accurately as possible. The accurate measurement of differences among individuals and groups has been greatly facilitated by the use of statistical procedures. Statistics are used, first of all, to determine the trustworthiness of a particular measuring instrument. Secondly, statistical techniques help the psychologist organize and interpret vast amounts of information about individuals or groups whose behavior he wishes to understand and compare.

But the psychologist has not always had such instruments and techniques for measurement and analysis. Thus much that has been written about the growth and development of human personality has been based on "naked eye" observation. The early work of such great clinicians as Freud, Adler, and Jung not only has enriched our language and literature with expressions like *extraversion* and *inferiority complex*, but also has supplied the modern psychologist with numerous hypotheses to be tested by the more rigorous methods now available.

Chapter 2

Outline

HEREDITY AND MATURATION
ENVIRONMENT AND LEARNING
THE QUESTION OF INSTINCT

THE "THREADS OF LIFE"
SIMILARITIES AND DIFFERENCES IN FAMILIES
DOMINANCE AND RECESSIVENESS
SEX DETERMINATION
STUDYING TWINS

THE NERVOUS SYSTEM
THE MUSCLES
THE ENDOCRINE GLANDS

THE PHYSIOLOGICAL GRADIENT
MOTOR PRIMACY
INDIVIDUATION

STAGES OF PRENATAL DEVELOPMENT
TECHNIQUES FOR STUDYING FETAL BEHAVIOR
CHARACTERISTICS OF FETAL BEHAVIOR
EFFECTS OF UNFAVORABLE PRENATAL CONDITIONS

PHYSICAL STRUCTURE
SENSORY CAPABILITY
RESPONSIVE CAPABILITY
EARLY SOCIAL DEVELOPMENT
SPEECH RESPONSES

THE EFFECTS OF AN IMPOVERISHED ENVIRONMENT
THE EFFECTS OF AN ENRICHED ENVIRONMENT
DEVELOPMENTAL TASKS

THE PRIME OF LIFE
METHODS OF STUDYING GROWTH AND DECLINE

DEVELOPMENTAL TASKS

THE INFLUENCE OF ENVIRONMENT

THE GROWTH AND DECLINE OF HUMAN ABILITY

Chapter 3 The Development of Behavior

Whenever a child is born, the focus is on the future. The parents look forward eagerly to each milestone in his development—his first smile, his first word, his first step. In the back of their minds at all times is the question: What kind of individual will this new person be? And even more important, what can they do to ensure that his future will be happy and that he will become a useful member of society?

DETERMINERS OF DEVELOPMENT

To understand the development of the human personality it is necessary to study the actions and interactions of heredity and environment through time. *Heredity* is defined as the totality of biologically transmitted factors that influence the structure of the body. *Environment* is the totality of conditions that serve to stimulate behavior or act to bring about modification of behavior. The action of these factors in determining the level of an individual's biological, psychological, and social development is sometimes expressed in the following formula:

$$\text{heredity} \times \text{environment} \times \text{time} = \text{developmental level}$$

This formula, admittedly oversimplified, highlights the fact that it is meaningless to speak of either heredity or environment acting alone. Both are necessary for any development at all to take place. Heredity could not operate except in some sort of environment, whereas even behavior that we describe as environmen-

tally caused must obviously be carried out by inherited body structures.

In studying the relationships between heredity and environment, it is not enough to ask which of the two is primarily responsible for a given aspect of development or even in what proportions the two have contributed. The important question is how they *interact*. For example, heredity is mainly responsible for giving us a particular body build, complexion, or cast of features. Any society is likely to prize certain combinations of these physical characteristics and frown on other combinations. A person born with a set of hereditary characteristics that make him the object of scorn or ridicule by his society may react to the discrimination against him by rejecting that society. Out of the interaction a juvenile delinquent—and eventually an adult criminal—may be created (Anastasi, 1958). "Billy the Kid," who was very sensitive about his shortness, is a well-known historical example. Both heredity and environment have played a part here, but through interaction rather than through simple addition.

What the formula given above fails to show is that at any given moment environment is interacting not only with heredity but with a level of development already reached (Hirsch, 1962). This level of development, in turn, reflects previous experience and thus is the product of both hereditary development and learning up to that point. For example, given a natural talent plus years of teaching and practice at home, the pianist Van Cliburn was able to gain admission to a famous music school and there develop his talent to the point where he could win the international Tchaikovsky competition in Moscow. Without the proficiency gained from his earlier practice, he would not have been ready to profit from the advanced instruction despite his inherited potential. One

of the great questions of interest to psychologists at present is whether the same development of hereditary potential is possible at any period in the life span or whether certain types of development must come at a particular time if hereditary potential is not to be permanently lost. Studies bearing on this question will be discussed later in this chapter.

The role of heredity in guiding an organism's development is clearly dominant prior to the moment of birth. Yet this is not to say that the unborn child has no environment, for within the mother's body he is surrounded by protective fluid and receives nutrients from the maternal blood stream. As we shall see, there is also some evidence that simple responses and even some learning can take place before birth. The main function of the prenatal environment, however, is to support the normal growth processes of the unborn child.

Heredity and Maturation

At birth, learning begins to play an increasingly important role in shaping new behavior patterns. Heredity does not cease to operate, however. Hereditary potentialities for a particular growth sequence and for many kinds of behavior typical of the species continue to develop for months or even years. This process by which heredity continues to function after birth is called *maturation*. One familiar result of maturation is the voice change that occurs in boys at the age of puberty. The boy's voice becomes lower because of a thickening in his vocal cords, which results from increased functioning of the portion of the ductless gland system that produces the male hormones. Although the low voice of the adult male does not develop until long after birth, it is nevertheless determined by heredity—acting through maturation. Observation of boys who have grown up out of touch with other boys shows that even in the absence of knowledge of this change, the characteristic lowering of the voice takes place at adolescence. Clearly, it is not learned. At a much lower level is the pecking response by means of which the baby chick or other bird breaks the egg and frees itself. Such behavior is obviously unlearned and ap-

pears only after a period of maturation has elapsed.

Evidently, then, a number of physiological structures are essentially mature and ready to function at birth or even earlier, whereas other nervous, muscular, and glandular structures are not ready to function until months or years later. Until these structures are mature, no stimulus will be effective in producing the type of behavior which they underlie.

Environment and Learning

Most patterns of behavior, of course, depend on learning as well as on a certain level of maturation. Until neural and muscular structures are sufficiently mature, no amount of instruction and practice can teach a child to read; yet even when the structures are ready, no child is able to read without learning.

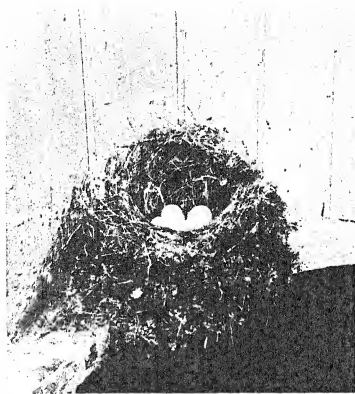
In addition to providing the conditions necessary for life and growth, the environment influences the development of behavior in two ways: (1) it supplies stimuli which elicit patterns of response already prepared by maturation, and (2) it presents situations that require the learning of new responses or the changing of old ones. Each individual's environment, through its social patterns and through the resources it provides or fails to provide, determines what patterns of behavior will be necessary for that individual to learn.

Given an adequate environment, each individual develops at his own rate. Psychologists and physiologists have been able to outline a general developmental schedule which, under normal conditions, is characteristic of human development. Knowledge of this schedule, which is based on a comparison of great numbers of individuals, not only aids our understanding of man as a species but is useful in studying individuals.

The Question of Instinct

The question of whether human beings possess inherited "instincts" which govern their behavior was for years the subject of a heated but futile controversy. Although complete

Although there is a characteristic pattern for every form of instinctive behavior, this pattern varies in individual cases, depending upon the particular stimulus provided and the demands of the environment. An example of variations in nest-building behavior brought about by differences in environment is found in the two phoebes' nests pictured here. A nest built under a concrete bridge (left) is composed primarily of mud, which adheres to the concrete. A nest built on a schoolhouse rafter (right), however, has less of a gravity problem; therefore less mud is required, and the nest accordingly consists mainly of grasses cemented with mud.



agreement is still lacking, this controversy today is mostly a matter of historical interest to psychologists. As with most controversies, the root of the difficulty was a failure to define terms adequately. In fact, for a long time many psychologists were unwilling to use the term "instinct" at all because there was no general agreement as to just what it meant. More recently, however, the term has been redefined, and it is now generally agreed that *an instinctive behavior pattern is one whose underlying biological pattern has been produced by maturation rather than by learning*. It is inborn—a product of heredity—although it may not appear until months or even years after birth. It is found in all members of a species, regardless of differences in their environment. Once the underlying biological pattern is mature, a behavior pattern that is truly instinctive will appear "full-blown" upon the first occasion that

an adequate stimulus is presented, without previous opportunity for learning. The last part of the definition is what distinguishes it from the earlier concept, which defined instincts as operating without reference to environmental opportunity or stimulation. Even in the clearest case of instinct, it is accepted by all modern psychologists that some stimulation is required. Some variation of the usual pattern of the instinctive behavior also occurs as a result of variations in the exact stimulation received from the individual's particular environment.

Instinct in lower animals. A classic study of the development of swimming in tadpoles strikingly illustrates the role of maturation in certain behavior patterns of animals.

Frogs' eggs were placed in a solution of chlorotone, an anesthetic which stops all responses to stimuli but

does not interfere with normal growth. These animals could develop through maturation but not through learning, since stimulation is presumed to be essential to learning. They were in effect developing in a psychological vacuum.

Tadpoles in a control group were kept under the same conditions of temperature and light as the experimental group but were allowed to swim freely in pure water. Thus they were exposed to the joint influences of maturation and stimulation.

When the control animals—those exposed to both maturation and stimulation—had reached the stage of free swimming, the experimental animals were removed from their anesthetic solution and placed in pure water. Though they had had no chance to learn, they swam just as well as the normal ones when allowance was made for the time required for the anesthetic to wear off. The conclusion was that the ability of tadpoles to make swimming movements was one that developed through maturation in the absence of learning prior to the test period (Carmichael, 1926).

This study demonstrates the fact that *in low-er animals* maturation can cause behavior patterns to emerge in practically complete utility when there has been little or no previous stimulation or learning. We say “practically complete” because even where maturation is clearly the chief guiding force, some learning may be involved in the development of a particular behavior pattern.

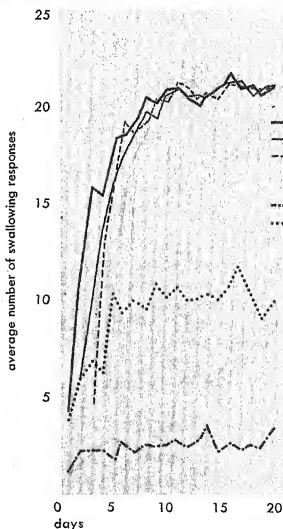
In one experiment on so-called “instinctive” behavior, the experimenter divided 202 chicks into eight groups. The first five groups were kept in darkness for one, two, three, four, and five days respectively, being artificially fed and watered by hand, after which, following twelve hours without food, they were brought into the light and allowed to practice pecking as much as they liked. Thus the motivation to peck (hunger) was equal for all groups. After only seven days’ practice Group E, confined for five days, reached the same proficiency of pecking—measured by the swallowing reaction after an accurate peck and successful grain pickup—as Group A, confined only one day but released at a less mature level of development.

This looked like a simple case of more mature individuals needing less practice. However the actual amount of practice had not been controlled and had actually been extensive in all cases. Accordingly three other

groups—F, G, and H—were given different amounts of practice with their level of maturation held constant. All started practice after one day of confinement; thus they were comparable to Group A in terms of level of maturation. They were given varying amounts of practice each day and were kept in darkness the rest of the time. Group F had twelve pecks per day; Group G, twenty-five pecks per day; Group H, twelve pecks per day for the first ten days, and twenty-five pecks per day thereafter.

The curves for these groups show the extensive practice needed to develop proficiency even in this apparently

MATURATION AND PRACTICE INTERACT



Key:

A-B-C-D-E unlimited pecking

F-12 pecks a day

G-25 pecks a day

H-12 pecks at first; later 25 pecks

Based on Cruze, 1935

instinctive behavior. When level of maturation was held constant, the proficiency the chicks developed was in direct proportion to the amount of practice they had. On the other hand, when unlimited practice was allowed all the way through, the level of maturation clearly set the upper limit for possible proficiency (Cruze, 1935).

Experiments with human subjects. In human infants, the importance of maturation in guiding basic early behavior patterns is seen in comparisons of two groups of Hopi children. Those in one group were allowed freedom of movement during their early months, whereas those in the other group spent many hours a day bound to a board carried on the back of the mother. Although the cradleboard almost completely restricted leg movements, the children reared on it began to walk at the same average age as those who had not been bound (Dennis, 1940). The time of beginning to walk was evidently set by maturation.

This finding is consistent with the results of a classic experiment. Children between the ages of two and three years were divided into two matched groups. One of these, the practice group, was allowed to climb a two-and-a-half foot ladder to a table top on which interesting toys had been placed. By the end of the twelfth week, this group had acquired considerable skill.

The other group had no opportunity to practice climbing—although they did, of course, practice other habits, such as walking, which have something in common with ladder climbing. At the end of twelve weeks this group was also given a table full of toys which could be reached by a ladder. Within a week these children were climbing just as well as the practice group could (Hilgard, 1932).

The second group in this experiment was able to catch up quickly with the practice group because at a later stage of maturation less practice was required to achieve a given level of performance.

We do not know exactly how long it is possible to withhold the opportunity for learning without producing a permanent loss in capacity to learn. What evidence exists, however, suggests that there may be a particular age at which a given skill can be learned with greater

● This picture shows one of the types of cradle boards used with Hopi children.



case than at any other time, either earlier or later.

A psychologist who has had a great deal of experience in teaching people of all ages how to swim makes the following observation:

"I find that age seven or eight is perhaps optimal. Some children do learn earlier, but with the majority it is a waste of time to attempt to teach them. Later, there seems to be an emotional block; I have observed this with adults whom I have helped learn—perhaps they grew up in a desert region. Note I have the advantage of their coming to me, so they want to learn; yet they are scared, or at least not relaxed, in the water." (Husband, 1965)

Despite the great importance of maturation in guiding and limiting behavior in human beings, as in other species, purely instinctive behavior is very rare in man. His nervous system,

especially his brain, makes him much more able than lower species to adapt to variations in environmental stimulation, with the result that whatever instincts he may start with are rapidly overlaid by the effects of learning. It is highly doubtful whether the human adult exhibits

any purely instinctive behavior. Particular human behavior patterns fall somewhere on a continuum between pure instinct and pure learning, depending upon the degree to which learning has interacted with maturation in their development.

THE MECHANISMS OF HEREDITY

The process by which an individual develops from a single-celled organism into an adult human being, with his many billions of cells and his remarkable physical and mental capacities, is wonderfully complex. As E. G. Conklin, a great American biologist, once said, "The development of a human being . . . is the climax of all wonders." (Conklin, 1923)

The "Threads of Life"

At the time of conception, two living *germ cells*—the *sperm* from the father and the *ovum*, or *egg*, from the mother—unite to produce a new individual. The male and female germ cells are known technically as *gametes*, and the single cell they form at the moment of conception is called the *zygote*. Both the egg and the sperm contain tiny thread-like structures called *chromosomes*. These have been called, somewhat poetically, the "threads of life."

In 1962 the Nobel Prize for Medicine and Physiology was awarded to Francis Crick, James Watson, and Maurice Wilkins for their discoveries regarding the chemistry and mechanics of heredity. Each chromosome is made up of long molecules of deoxyribonucleic acid, called DNA for short. The atoms of a DNA molecule are arranged in two long strands twisted together in a complex double spiral, as shown in the diagram. ♦ Along each spiral are ultramicroscopic areas called *genes*, which are the bearers of heredity. The order of the atoms which make up a particular gene serves as a blueprint

or master code which governs the formation of the parts of the body for which that gene is responsible. The branch of biology concerned with the mechanisms of heredity is called *genetics*.

The all-important function of DNA as the chemical basis for the inheritance of characteristics has been proved in the case of one-celled organisms. The investigators observed that DNA taken from one species of bacteria and mixed with that of another closely related species produced structural changes that were passed along to succeeding generations (Marmur and Lane, 1960).

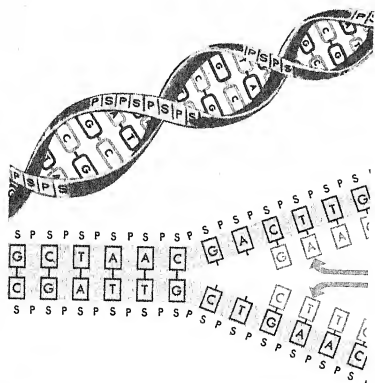
The human zygote contains forty-six chromosomes—twenty-three from each parent. ▲ Recent studies have found an abnormal number of chromosomes, (a number other than forty-six) associated with structural abnormalities. For example, some women who lack ovaries are found to have forty-five chromosomes, and Mongolian idiots have been found with forty-seven (Stern, 1960).

When the zygote is formed, the chromosomes from two parents "line up" and function as pairs. Then, as the zygote divides and redivides into more cells, the chromosomes divide similarly, so that there are the same number in each new cell.

Similarities and Differences in Families

After birth, the same process continues during normal body growth, each pair of chromo-

somes being duplicated in each new cell that is produced. But in the development of the gametes a special kind of cell division—*reduction division*—occurs, with the result that each mature egg or sperm contains only one chromosome from each pair. Thus only *half* of each parent's chromosomes are transmitted to each child. And because a process of chance selection determines whether a particular germ cell contains one chromosome or the other from each pair, different combinations of chromosomes—



Adapted from Beadle, 1964

◆ The long double spiral of the DNA molecule resembles a ladder in which the rungs are made up of pairs of four chemicals: adenine and thymine (A and T) or cytosine and guanine (C and G) and the sides are made up of alternating sugar and phosphate (S and P). A single DNA molecule may have several thousand of these paired units. The instructions they encode are like long sentences in which the genes are phrases. A DNA molecule replicates itself by unwinding, separating down the middle like a long zipper, and picking up the appropriate new units from the surrounding fluid. DNA is so tiny that all the DNA strands in the egg cells that have given rise to the approximately three billion people living today would fit into a $\frac{1}{8}$ inch cube (Beadle, 1964).

▲ This was one of the early photomicrographs that established the number of human chromosomes at forty-six instead of forty-eight as previously believed. The same technique of spreading and photographing chromosomes has also made it possible to identify the particular chromosomal abnormalities which are associated with certain defects in the development of the organism. Such defects thus are now seen to be the result of missing or garbled "instructions" from the DNA.



and hence different genes—are transmitted to different children of the same parents. This process of reduction division explains why a child is both like and different from his siblings, parents, and grandparents, as well as other relatives. Only identical twins, who develop from a single egg that splits in two after having been fertilized, have identical chromosomes and genes.

In the past, variability among offspring of the same parents was attributed entirely to different combinations of unchanging chromosomes—unchanging, that is, except for occasional mutations. It is now known, however, that prior to or in the process of reduction division, chromosomes often break apart and exchange parts

with each other, so that genes originally inherited in chromosomes from one parent may cross over and be passed along to the next generation in a chromosome inherited from the other parent (Montagu, 1959; Hirsch, 1962). This process adds to the nearly infinite possibilities for variability among the offspring. These findings show how important it is to expect and measure variability among the organisms of a species rather than to try to construct laws of behavior about an "average" being.

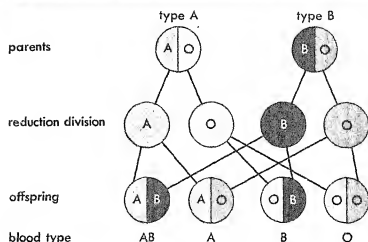
Dominance and Recessiveness

The phenomenon of dominant and recessive genes also helps explain how heredity can produce differences as well as resemblances among the members of a family. Sometimes the genes given to the individual by both parents have the same effect, as when the child receives only genes for black hair. But in other cases, the child receives genes that are determiners of different characteristics—as, for instance, genes for blond hair and genes for black hair. A gene that takes effect in the child whether or not it is paired with a like one is said to be *dominant*; a *recessive* gene is one that is ineffective unless it is paired with one just like itself.

An example of the operation of dominant and recessive genes is shown in the determination of blood type. There are four blood groups or types: A, B, AB, and O; determined by three genes: A, B, and O. Each person receives a pair of such genes, one from each parent. A and B genes are equally expressive and both are dominant over the O gene. Therefore, a person can have type O blood only if he has received an O gene from each parent. If one parent has the blood genes AO (manifested as type A blood) and the other parent has the genes BO (type B blood), all four blood types may be represented among their children.

At the present time we do not know exactly how many cases of dominance occur in the human being. Many traits, however, are definitely known to be dominant. Among these are some types of skin and brain cancers, drooping eyelids, cataracts, certain muscular troubles, white forelock ("blaze"), baldness (dominant in men only), and dwarfism. Many less dramatic traits

INHERITANCE OF BLOOD TYPE



Based on Montagu, 1959

are probably also dominant, but they are less easily observed and traced.

There are also many recessive conditions, such as taste blindness, a rare type of complete color blindness, some types of visual and hearing defects, certain kinds of paralysis, some neuritis, albinism ("dead white" skin with pink eyes and white hair), possibly certain types of mental disease and epilepsy, and *amaurotic family idiocy*, a rare form of mental retardation.

When an organism has two different genes controlling a trait, it is said to be *heterozygous* for that trait; when the two genes are the same, it is said to be *homozygous*. In general, it appears to be better for an organism to have two different genes in a pair than two identical ones. Farmers as well as scientists have long observed "hybrid vigor"—the tendency of mixed plants to be stronger than purebred ones.

Interestingly enough, there is evidence that the genes themselves tend to produce heterozygosity just as the body tends to preserve advantageous conditions of temperature, chemical balance, and so on (Lerner, 1958; Hirsch, 1962).

Sex Determination

Since the fertilized egg receives exactly half of its chromosomes from the father and half from the mother, the child does not (despite popular belief) inherit more characteristics

from the parent of his own sex. The characteristic of sex, however, is determined by the male gamete alone. In the female, the pair of chromosomes that determine sex are both of the same kind, called *X chromosomes*; the male has one *X chromosome* and one of a different kind called a *Y chromosome*. Following reduction division, half of his germ cells will thus contain *X chromosomes* and the other half *Y chromosomes*. If a sperm containing an *X chromosome* fertilizes an ovum, the child will be a girl; if one with a *Y chromosome* does so, the child will be a boy. Thus the father who is disappointed when a daughter is born has no grounds for blaming his wife. The father who hopes for a boy has the odds slightly in his favor, however, for 106 boys are born for every 100 girls.

For centuries people have wished that they could foretell the sex of their offspring. The man who desires a son and heir or the woman who longs for a daughter after having borne three or four sons often feels that scientists should work harder to find a way of predicting sex. This hope is finally becoming a reality. Although there is no known way to assure that a *Y*-bearing sperm rather than an *X*-bearing one will unite with the egg cell, once the union has occurred all the cells of the new organism are distinctively marked as male or female. Cells of a female organism bear a microscopic structure called the *chromatin body*, which can be identified in the laboratory because it will take a deep stain whereas cells of a male organism will not (Barr, 1959). Free-floating cells are found in the fluid surrounding the fetus and may be obtained by withdrawal of some of the fluid

through a needle. This is occasionally done for medical reasons when there is an excessive amount of fluid, but the process is too dangerous to be done merely to satisfy parental curiosity. The hope remains, however, that a more satisfactory means of obtaining cells will be developed, with the result that more parents may learn the sex of their child ahead of time.

Studying Twins

In research where it is important to hold constant the effects of hereditary factors, psychologists find it convenient to study *identical twins*. Identical twins are descriptively named *monozygotic*, indicating that they have developed from a single fertilized egg, or *zygote*. Shortly after conception the *zygote* splits into two separate cells, each of which then develops into a complete organism. Since both babies originate from the same sperm and egg, they are assumed to have identical heredities and will resemble each other in sex as well as in all other inherited characteristics.

In contrast, *fraternal twins* are called *dizygotic* to indicate that they have developed from two separate *zygotes*, each produced by the union of a sperm cell with an egg. Fraternal twins may be of the same or different sexes and will not resemble each other any more closely in their hereditary make-up than will ordinary siblings. (Biologists and psychologists apply the term *sibling* to brother-brother, sister-sister, and brother-sister combinations. Both types of twins, of course, are siblings, but siblings may or may not be twins.)

INHERITED STRUCTURES

The mechanisms of heredity serve in much the same way as the program of a modern electronic computer. Just as the program tells the computer what to do with the information fed into it, so the genes "tell" the organism how to use the materials of the environment to grow

and develop and how to maintain a proper balance of internal conditions.

We are "programed" in such a manner that our most rapid growth occurs during the prenatal period. The rate of growth continues to be high during the first year but then slows down.

It is slowest during the middle school years and then takes a sudden spurt near the start of adolescence. Because girls, on the average, start their adolescent development somewhat earlier than boys, there is a period of a few years when girls tend to be somewhat taller and heavier than boys of the same age.

Physical growth during childhood and adolescence also brings about changes in body proportions. By the time the individual has reached physical maturity, the proportionate size of the head is much smaller than during infancy, whereas the trunk and limbs are proportionally longer. These changes greatly increase the grace and efficiency of the individual's body movements. There are, of course, many deviations from this general pattern of development and each of us comes to have a unique appearance of body and features.

Under the guidance of heredity, the organism living in a normal environment undergoes a process of growth involving three important sets of structures: the *nervous system*, the *muscles*, and the *endocrine glands*.

The Nervous System

The development of behavior depends directly on the maturation of the nervous system—the intricate chains of nerve cells which form the neural patterns underlying all adjustive responses. As the child develops, improvements in his ability to make adequate adjustments are closely associated with two important changes in his nervous system: (1) an increase in the size of his brain and (2) an increase in the complexity of the neural patterns connecting receptors and effectors.

Brain size. During the first few years of childhood, increases in the size of the brain give a rough indication of its increased capacity to function. By the time of birth the individual already has the full number of brain cells, but many of these cells are still not sufficiently mature to function. This is particularly true of those in the cerebral cortex. The behavior of the infant during the first few weeks of life, therefore, is largely confined to reflex responses and mass involuntary movements that operate

mainly through the spinal cord and lower brain centers, which are already fairly well developed.

During infancy the brain grows at a faster rate than most other body parts. From about the fifth to the eighteenth month after birth, the cerebellum, which controls coordination of movements, grows very rapidly in relation to the other parts of the brain. This is the period when the infant learns to sit up and crawl and begins to walk, activities all heavily dependent upon coordination.

By the time the child enters school, his brain has nearly reached its adult size, although its functional capacity will continue to increase for years. Several attempts have been made to establish a relationship between brain size and intelligence, but except in cases where the number of brain cells is extremely deficient, investigators have been unable to find any relationship.

Neural patterns. The maturation of patterns in the nervous system can be likened to the branching out of a growing tree. At first there are only a few main nerve fibers, but as the organism develops, these "trunks" give off branches which establish connections with similar branches growing from neighboring nerve cells. In this manner a single nerve cell may make contact with hundreds of others, and an intricate network of neural interconnections is established.

During the process of neural maturation a great number of alternate pathways are laid down, making possible a variety of responses to a given stimulus. Such neural associations established by maturation are called *structural connections*. Some structural connections are not biologically capable of transmitting nerve impulses. For those that are, two factors determine whether they will ever become *functional*—that is, whether they will actually participate in the transmission of a nerve impulse.

1. Receptors, as we have seen, normally respond only to a specific kind of stimulus. Unless the appropriate stimulus is administered with sufficient intensity, a neural pattern will not function. Thus, the unborn child's visual structures may be ready to function, but the fetus actually sees nothing because there are no light stimuli in the womb.

2. Neural connections which have been ineffective, though complete, may become functional through learning. A great deal of research is currently focusing on the question of just what processes occur in the nervous system when learning takes place.

In short, the complex network of neural interconnections underlying all behavior is laid down by the process of *maturation*, but stimulation determines whether they will be used, and learning may change the basic patterns. Although the richness of potential connections increases as maturation proceeds, opportunity still determines the extent to which they become functional.

The Muscles

Often a child, because he lacks sufficient muscular maturity, is unable to perform some pattern of behavior which will come easily at a later age. Although the infant has his total number of muscle cells at birth, they grow in size and strength through both maturation and exercise. The neural patterns underlying walking movements are well developed shortly after birth, but most babies cannot walk before their second year because until then their muscles are too weak to support their bodies and because, as we have seen, the neural mechanisms for coordination are not ready. ▲

Muscular development is slow throughout early childhood. Studies indicate that a person still has to gain about four fifths of his total strength after the age of six, although he has attained two thirds of his adult height by that time. Muscular growth is most rapid during adolescence, when the individual begins to "fill out" and approaches adult height and proportions. In tests of pure muscular strength such as hand grip, both boys and girls show steady increases throughout adolescence, although boys display more marked increases and continue to develop over a longer period of time than girls (Jones, 1949). In athletic skills such as the fifty-yard dash and the broad jump, for instance, boys improve regularly during adolescence, whereas girls level off at about the age of thirteen and then actually decline in proficiency (Espenschied, 1940).

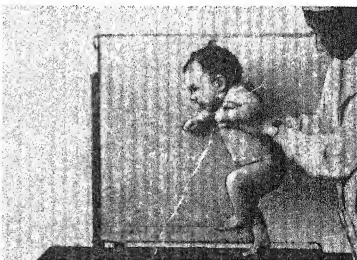
The Endocrine Glands

One of the important groups of inherited structures influencing the course of development is the endocrine system. The locations and general functions of the glands in this system were discussed in Chapter 2. The endocrine glands which are most closely involved in development are the pituitary, the thyroids, the adrenals, and the gonads.

The pituitary. The most important endocrine gland associated directly with physical development is the pituitary. Improper functioning of this gland in producing the pituitary growth hormone may result in such abnormal conditions as *giantism*, *acromegaly*, or *dwarfism*.

Giantism is the result of an early excess of the pituitary growth hormone. During the period of oversecretion, the person may grow as tall as nine feet; then the amount of secretion declines, usually leaving the individual strong in appearance but actually with much weaker muscles and less sexual appetite than the normal individual. Fortunately, giantism can be prevented by surgical removal of some of the excess glandular substance if the condition is recognized early enough.

Acromegaly, like giantism, results from an oversecretion of the pituitary growth hormone. But here the oversecretion starts later in life,



▲ Even a newborn infant makes walking movements when supported so that his legs do not have to bear his body weight.

◆ Maurice Tillet, a French wrestler, is shown after getting his U.S. citizenship papers. He became aware of acromegaly in his late teens. Notice particularly his long jaw and enlarged hands. Although he graduated from college and attended law school, he capitalized on his unusual appearance and great strength to make a successful career in wrestling as "The Angel."



producing an overgrowth of only portions of the skeleton instead of the whole body. ◇ Characteristic of acromegaly are enlarged hands, arms lengthened until the fingers reach knee level, heavy jawbone, greatly expanded chest, and bent back. This condition is sometimes accompanied by various symptoms of personality disorder. These may arise in part from the individual's feelings about his body deformity, but they also are a direct result of the hormone imbalance, which disrupts the functioning of the nervous system.

On the other hand, there is sometimes a deficiency of the pituitary growth hormone in early life. Such a deficiency results in underdevelopment of the bones, or *dwarfism*. ◇

Many of the pituitary's "middle man" hormones are not produced in quantity until the onset of adolescence, when they begin to prompt activity in the glands that control the development of mature sexual characteristics. Failure of the pituitary to produce these "middle man" hormones at the proper time can delay sexual maturation, whereas early release of

the "middle men" has been known in extreme cases to cause the appearance of mature sexual characteristics even in infants.

The thyroids. Extreme thyroid deficiency during infancy or early childhood results in a condition known as *cretinism*. The primary symptom of this disorder is retarded development, particularly of the skeletal and nervous system, resulting in a peculiar type of dwarfism generally accompanied by low-grade intelligence. This intellectual retardation appears to stem mainly from poor development of nervous tissue, particularly in the brain. When extreme thyroid deficiency occurs during the first two years after birth, during the time when the cortex of the brain is normally growing very rapidly, adverse effects on the child's intelligence are particularly striking. With proper hormone treatment, however, about a fourth of such children eventually achieve normal intelligence. Children who are over two when the disorder occurs develop normal intelligence, under treatment, in about 90 per cent of cases.

The adrenal glands. As we saw in Chapter 2, the adrenal hormones which play a role in development are those produced by the cortex, or outer layer, of the adrenal glands. Of major importance are the *adrenal androgens*, which regulate the development of certain adult sexual characteristics, particularly those associated with masculinity. These hormones, which the adrenal cortex normally begins to secrete just before adolescence, are partly responsible for adult hair distribution and lowering of the voice—changes that occur in both sexes, although they are more marked in boys. Adrenal hormones also contribute to the appearance of pimples, frequently an embarrassing complaint of adolescents. In producing such changes, the adrenal hormones work in conjunction with other androgens produced by the sex glands, which also begin functioning actively at this time.

Overactivity of the adrenal cortex produces both increased body activity and an accentuation of masculine characteristics, such as growth of beard and deepening of the voice. This condition, known as *virilism*, may occur in either sex. The "bearded lady" of the circus is

probably the victim of an overactive adrenal cortex. When the adrenal cortex becomes overactive in early childhood, physical changes may occur which give the appearance of sexual maturity, although the reproductive glands themselves do not generally become active unless the real trouble is a malfunctioning of the pituitary, which can stimulate activity in *both* the adrenals and the sex glands.

The gonads. The gonads secrete small amounts of hormones into the bloodstream during childhood, but do not begin to influence development significantly until the onset of adolescence—by definition, the period of life when the process of sexual maturation occurs. At approximately the age of ten or eleven for girls and thirteen or fourteen for boys the gonads increase their production of hormones enormously. They do not normally begin producing

mature sperms or eggs, however, until after two to four more years. Meanwhile, before the onset of *puberty* (the stage of development when reproduction first becomes possible), the sex hormones are producing bodily changes that prepare the individual for parenthood. After puberty, adolescence continues for a few more years until the person has reached his full strength and stature.

The male sex hormones produced by the testes are called *testicular androgens*. In many respects these are similar to the androgens secreted by the adrenal cortex, but the testicular hormones normally have much the greater effect. Although they do not work alone, the testes are the major glands underlying the development of masculine characteristics during adolescence. One of the earliest signs that the testes have become active is an increase in muscular and skeletal growth. (The fact that boys eventually become taller and stronger than girls can be attributed partly to the work of their hormones.) In addition to guiding the maturation of the male reproductive organs, the testicular androgens are responsible for the appearance of sexual arousal and for the energetic and aggressive behavior common among adolescent boys. Premature secretion of these hormones or artificial injection of them can cause premature development of adult features.

Lack of male hormones resulting from injury or surgical removal of the testes (*castration*) can produce striking changes in an individual's development and behavior. Males who are castrated before the age of puberty develop into adults lacking sexual appetite and initiative. They even retain the high voice of childhood. Most of these symptoms can be dispelled by the artificial administration of male sex hormones, although castrated males have permanently lost their capacity to reproduce.

In the female, the ovaries produce two main types of hormones: (1) the *estrogens*, which promote growth in the reproductive organs and other body parts important to childbearing and motherhood, and (2) *progesterone*, which prepares the uterine tissues for supporting fetal life. The exact age at which adolescence commences in females is often difficult to observe, since the first effect of increased ovarian activity is the growth of the internal reproductive or-



⑥ The little girl here was suffering from the type of dwarfism caused by too little pituitary secretion. She is shown at age six (left) and again a year and a half later after investigative therapy with daily administration of a growth hormone.

gans. The first obvious indicators of adolescence are the budding of breasts and the appearance of hair in the genital region. At about the same time, changes in skeletal proportions begin, particularly a widening in the area of the hips. Between the ages of 12 and 14 most girls reach *menarche*, the stage at which menstruation first occurs. All these changes are due mainly to the activity of the estrogens.

Even when menstruation begins, a girl has not reached puberty in a technical sense—that is, pregnancy is not possible for several months more. During the period between menarche and puberty the second female hormone, pro-

gesterone, becomes active and produces changes in the uterus which enable it to support and nourish a fetus. Once this is accomplished, growth soon ceases and adolescence comes to an end. Boys, on the other hand, generally continue growing for a few years after they reach puberty.

All the maturational changes influenced by the endocrine system are primarily the result of hereditary factors working over a period of time. Presumably the nervous system stimulates and controls the endocrine glands in accordance with the master “blueprint” present in the genes.

From the instant of conception to the age of full maturity *maturation follows an orderly sequence*. New structures and functions always appear in a definite order, and each new behavior pattern that appears sets the stage for the next.

The Physiological Gradient

In its orderly course, maturation proceeds along a *physiological gradient*. That is, it begins in the head region and gradually extends throughout the organism to the feet, as shown in the gradual extension of sensitivity in the fetus. Maturation also proceeds from the trunk outward to the extremities: the child moves his shoulders before he can move his elbow, wrist, or fingers. The fact that maturation is orderly does not imply, however, that it is automatic. On the contrary, the innate potentialities of the organism can unfold only when environmental conditions are favorable.

Because of the hereditary differences among individuals, however, *maturation is not uniform for all children*. Though the same general sequence is followed, there are noticeable

differences in the rate, pattern, and extent of individual development.

Motor Primacy

The neuromuscular structures of the body must reach a certain stage of maturation before they are capable of responding to stimulation (Bousfield, 1953). This is called the *principle of motor primacy*. For example, regardless of the amount of training he receives a child cannot walk until the necessary physical structures have developed. The individual's maturational level at any time limits the potential effectiveness of his environment at that time in stimulating activity and subsequent development. But as we shall see later on in this chapter, the lack of adequate stimulation from the environment can cause the organism to fail to develop the potential it should have at a given age.

Individuation

The newborn baby is not as passive and helpless as the earlier American learning theorists

THE COURSE OF MATURATION

(especially the behaviorists) would lead us to believe (Peiper, 1963; Kessen, 1963). He is fairly active and in interaction with his environment to some extent from the moment of birth. He just becomes more so as he matures.

In the earliest stages of maturation, the whole organism usually acts and reacts in a generalized way. As maturation progresses, certain parts become differentiated and integrated to produce more precise and more effective reactions. Thus three somewhat overlapping stages can be expected: (1) a stage of global, undifferentiated mass activity, (2) a stage of differentiation in which body parts can be moved individually with the rest of the body remaining quiet, and (3) increasing coordination and integration of individual responses. Most movements of the newborn infant are random and undifferentiated at first, but as time goes on they become more differentiated. For example, the hand becomes able to grasp without the whole torso being involved in the movement. Coordination or integration, though dependent upon the interaction of the differentiated parts, takes place at the same time that differentiation is occurring.

This pattern of *individuation*—of development “from the whole to the part, from the random to the orderly, and from the general to the specific”—usually is characteristic not only of the maturation of body tissues and muscular activities but also of the development of complex emotional and intellectual adjustments throughout life. It is not an absolute law of growth, however. In studies of mammalian embryos, it has been observed that even during embryonic life certain reflexes appear in specific

form without being preceded by any generalized mass activity (Windle, 1944).

When specific reflexes are available, it is the strength of the stimulus that determines whether they or a more generalized reaction will be called forth. Thus a light pressure applied to the eyelid of a fetal guinea pig releases a specific, localized response, whereas a heavy pressure is more likely to elicit movements of the whole body (Carmichael and Smith, 1939).

The particular pattern of development seems to vary with the adjustive needs of the species being observed. For example, the salamander comes into the world with a yolk sac that provides food for a period; it first starts to develop locomotion by swimming at about the time the food runs out. For quite a while this pattern is about all that it needs to find food. In fact, the salamander, being an amphibious animal and low in potentiality for manipulative skills, has little use at any time for precise behavior patterns. The guinea pig, on the other hand, must develop a large number of specific manipulatory reactions very early in life if it is to survive. It walks, runs, squeals, and eats almost from the moment of birth.

The salamander and the guinea pig illustrate the fact that behavior patterns of different animals mature in different ways. Sometimes the first patterns are crude; sometimes they are highly specific. Always the timing of maturational events is characteristic for the species and, in general, appropriate to the needs of the animal. Nature ensures that the growth of the nervous system takes place at the rate and in the order necessary to adjust the individual organism to its environment.

PRENATAL DEVELOPMENT

Secluded within its mother's womb, the prenatal child lives in an environment that is fairly constant from day to day and provides little or no opportunity for learning. Thus, by observing

the organism before and immediately after birth, we can study development steered largely by maturation, before its effects begin to be interwoven with the effects of learning.

Stages of Prenatal Development

Between conception and birth the human being passes through a series of developmental stages. The first of these, the *germinal* period, lasts for the first two weeks. During this stage the fertilized egg develops by a process of cell division into a hollow sphere of cells about one fifth of an inch in diameter. Then the *embryonic* period begins, as the first primitive structures of the new individual slowly begin to form. By the end of the eighth week, the heart has been beating for some time, the internal organs have begun to take shape, and the external physical characteristics have assumed definite form, even though the embryo is only about one and one fourth to two inches long. The organism, which becomes recognizably human at this point, is now called a *fetus*. The *fetal* period extends from about the eighth week until birth.

The entire term between conception and birth (normally about forty weeks) is called the *prenatal* period. From early in the prenatal period the organism is enclosed in a sac attached at one side to the mother's uterus and filled with *amniotic fluid*, which equalizes the pressure on the embryo. The embryo gets nourishment through the *umbilical cord* from the *placenta*, an organ that develops for this purpose. The placenta receives nourishment and oxygen from the mother's blood stream and passes waste materials from the fetal circulatory system back into the blood stream of the mother. There are no nerves connecting the mother and the unborn infant, nor is there any direct connection of blood vessels.

Some viruses can pass through the placenta to infect the fetus, as can drugs used to combat diseases of the mother or administered to her for other purposes. Thus physicians must be very careful about the medication they prescribe for pregnant women.

Techniques for Studying Fetal Behavior

The first observable muscular activity of the embryo is the rhythmic beating of the primitive heart. At first, heart action is independent of the still undifferentiated nervous system—and

hence is not regarded as *adaptive* behavior. Adaptive acts begin when a muscular response involving activity of the nervous system can be elicited by stimulation of a receptor (Carmichael, 1954). The human nervous system reaches this stage of functional maturity about eight weeks after conception, the approximate beginning of the fetal stage of development.

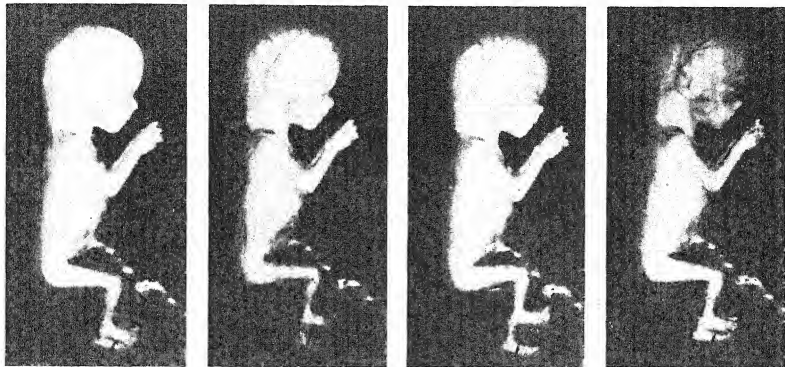
Most of our knowledge of the capabilities of the fetus at various stages of development has come from studying infants born prematurely after having spent as little as twenty-eight weeks (in rare cases, twenty-five) in the uterus. It is sometimes possible, however, to study the activities of much younger fetuses, when it is necessary to remove them from the mother's body for medical reasons. One investigator has studied the responses of very young fetuses to touch stimuli by placing them in a warm salt solution with the placenta in a separate jar under a moist atmosphere of oxygen. He has been able to begin his observations within two minutes after a fetus was removed from the uterus (Hooker, 1952).

It is always necessary to interpret the results of such observations with caution because premature delivery removes the fetus from its normal environment. When the fetus is in the uterus, it is constantly receiving oxygen and nutrients from the mother. Premature delivery breaks this connection, and although investigators simulate the prenatal environment as nearly as possible, they can never duplicate it. Moreover, the general anesthetic that is often used in such operations makes the fetus more sluggish than usual, less responsive to stimulation, and perhaps different in other ways as well. Fortunately, in many recent studies it has been possible to use local anesthetics which do not appear to affect fetal behavior. In some instances, observers have even been able to study the fetus while it was still in contact with the mother and receiving oxygen from her through the placenta.

Characteristics of Fetal Behavior

Studies of fetal behavior show two kinds of unlearned activities, spontaneous movements and externally stimulated movements.

▲ Movies were used to record the behavior of prematurely delivered fetuses. The sole of this fourteen-week fetus has just been stroked with a hair (left). The response (center pictures) is extreme flexion of the big toe, fanning of the other toes, flexion of the hip, and a slight backward movement of the foot. The fetus then returns to normal posture (right).



Spontaneous movements. The human fetus makes many movements of the head, trunk, and limbs which are "spontaneous" in the sense that they occur when no external stimulus is applied. Particularly after the fourth month the mother can frequently feel the movements of her unborn child. Certainly the fetus does not remain in the same position during its many months of prenatal life. A few weeks before birth it may become very active. The head turns from side to side; the arms and legs draw in and thrust out. The movements are slow and irregular, involving several joints at once, and often several members of the body move at the same time. This sluggish, irregular, widespread movement is aptly described as *mass action* or as *irradiation* (diffusing outward).

Externally stimulated movements. As early as the eighth week of prenatal life, the fetus becomes responsive to touch stimuli on the nose, lips, and chin, and the area sensitive to stimulation gradually increases with the passage of time. By the thirteenth or fourteenth week, the entire body is sensitive except for the top and

back of the head, which do not respond to stimuli until after birth.

Most early fetal responses to specific stimuli are more jerky than the spontaneous movements but still show gross irradiation—the application of the stimulus to one part of the body elicits a generalized response of several body members. ▲ Response to stimulation of the nose or chin includes movements of the trunk and neck and extension of the arms. Not all fetal responses, however, are generalized; some are quite specific, especially during the final months of the prenatal period. A touch applied to the lip, for example, arouses the response of opening and closing the mouth—probably the beginning of the sucking response. Touching the eyelid makes it contract. A landmark is reached at twenty-five weeks, when a fetus removed from the mother's body can carry on respiration for about twenty-four hours. The eyes also open and close spontaneously. Grasping and sucking movements appear at about twenty-nine weeks. During the final period of prenatal life these reflexes continue to mature.

Although the anatomical structures of most of the special sensory mechanisms are sufficiently mature to function before birth, it is not known whether the fetus actually responds to specific stimuli that happen to reach the mother's womb from outside. We do know that prematurely born infants are sensitive to temperature and taste but that their sensitivity to pain is weak. This delay in the development of the pain sense has been interpreted as a biological defense mechanism to protect the child during the birth process (Carmichael, 1951).

There is some question as to whether the fetus can hear in spite of the fluid in the ears. It has been found that the rate of the fetal heart-beat will increase sharply in response to a tone sounded close to the mother's abdomen (Bernard and Sontag, 1947). A team of Swedish investigators recently studied fetal reactions to tones of differing frequency.

Reactions of the fetal heart to tones of 1000 and 2000 cycles per second at an intensity of 100 decibels and a duration of five seconds were observed in this study, which involved thirty-two women in the last month of pregnancy. The pulses of the mother and fetus were registered before, during and after presentation of the tones. The acceleration of the fetal heart in the group tested at 1000 cycles per second averaged seven beats a minute. In the group tested at 2000 cycles per second, the acceleration was eleven beats a minute. The mother's pulse did not show any acceleration (Dwornicka, Jasien-ska, Smolarz, and Wawryk, 1964).

One point of especial interest in this study is that the higher tones produced a greater response. Studies of babies soon after birth show them to be more pleased, as inferred from their external behavior, by low notes than by high ones. These two observations suggest that the fetus is really hearing.

Prenatal learning. Although opportunity to learn in prenatal life is very limited, it has been demonstrated that the human organism is *capable* of learning simple responses during the last two months in the womb.

In an experiment on prenatal learning, preliminary investigations showed that a loud sound made just out-

side the mother's body elicited body-movement responses, whereas a vibrator applied to the mother's abdomen was not an adequate stimulus to cause the fetus to move. During subsequent learning trials the vibrator was applied to the abdomen for five seconds, during which time the loud sound was also produced. Fetuses moved in response to the vibrator alone after fewer than a hundred paired presentations of sound and vibrator. There were marked individual differences, however, in the number of trials necessary for the response to be learned (Spell, 1948).

Although our knowledge of fetal behavior is limited and incomplete, we know that such behavior is far from adequate for adjustment to the complex outer world. This inadequacy is due not only to physical immaturity but also to lack of opportunity to learn.

Effects of Unfavorable Prenatal Conditions

Every mother is concerned about the extent to which her child's development before birth can be affected by her behavior or by external events. Although many former beliefs about prenatal influences have been found to be false, certain conditions can indeed have a lasting adverse effect on an unborn child.

Emotional factors in the mother. Emotional disturbances in the mother can produce chemical changes which may be responsible for both structural and psychological abnormalities in the development of the fetus. For example, it is believed that emotional disturbances during the first ten weeks of pregnancy have caused some children to be born with a cleft palate. The bones which make up the palate develop between the seventh and tenth weeks, and one would expect that their development might be interfered with by chemical abnormalities at this time. This theory has been supported by experiments with mice and rats. If hormones associated with excessive emotional stress are injected into the mother at a particular period of pregnancy, almost 90 per cent of the young are born with cleft palates (Montagu, 1959).

A recent study has shown that anxiety in the mother during pregnancy is related to the

amount of crying behavior in the newborn baby.

A group of expectant mothers were tested for the presence of anxiety three times during pregnancy. Nineteen women earning extremely high or low scores were selected to test the hypothesis that there would be a positive relationship between the mother's anxiety scores during pregnancy and the behavior of the newborn infant. Body activity and crying behavior were recorded on the second, third, and fourth day of each baby's life. The hypothesis that the children of mothers with a high anxiety level would do the most crying was confirmed (Ottinger and Simmons, 1964).

This study, of course, does not necessarily prove that high anxiety of the mother *causes* emotionally upset behavior in the child. It is possible that the observed behavior of both mother and child is caused by a third factor such as heredity.

Improper medication. As we have seen (p. 84), drugs administered to the mother during pregnancy may pass through the placenta and affect the fetus. A tragic illustration of the need for precaution in prescribing medication occurred in the early 1960's, when it was discovered that *thalidomide*, a supposedly harmless sedative, had dangerous side effects when taken by women at a certain critical stage of pregnancy. The birth of hundreds of deformed babies, lacking hands and sometimes even arms, was traced to the use of this drug.

Even the use of medication to dull the pain of childbirth, so popular with modern women of the upper social and economic classes, may not be an unmixed blessing. Babies whose mothers had received heavy medication during labor were found to be less attentive and responsive after birth than were babies whose mothers had received lighter medication (Stechler, 1964). Follow-up studies are needed to see whether or not this effect persists.

Smoking. It has been clearly shown that heavy smoking is related to premature delivery, which places the infant under a severe handicap. In one study, for example, it was found that among nonsmoking mothers only 6.25 per

cent of the pregnancies terminated in a premature delivery, whereas among women who smoked thirty-one or more cigarettes a day the figure was 33 per cent—more than five times as great (Simpson, 1957). Data of this nature, of course, cannot tell us anything about cause and effect. It is possible that smoking causes premature delivery, but it is also possible that premature delivery and smoking are both caused by some third factor such as maternal anxiety. Again, correlation does not prove causation.

Radiation. The effects of massive doses of radiation are well known through the study of Japanese exposed at Hiroshima and Nagasaki. But with the testing of atomic weapons and the increasing peaceful use of atomic energy, many people are questioning what effects small amounts of radiation may have on congenital malformations. Indirect evidence comes from the finding that in certain areas of the state of New York, where a high natural background radiation results from the igneous rock present, there is a higher than normal rate of cleft palate and other congenital malformations. The rate in these areas was 20 per thousand live births during the eight-year period from 1948 through 1955, as compared with the statewide average of only 13.2 per thousand (Gentry, Parkhurst, and Bulin, 1959).

Although inadequate evidence makes it difficult to determine the precise effects of nuclear testing, the Federal Radiation Council (1962) has estimated that, as a result of testing through 1961, perhaps 110 children born in the United States of people now alive will show gross defects resulting from fallout. This is about one fortieth of the number of persons killed in motor vehicle accidents during 1961.

Birth injury. That injury in connection with birth can have dire consequences in the life of the child has been suggested by clinical studies. One study of prenatal and birth histories, for example, gave evidence of more delivery complications in a group of schizophrenic children than in a control group who were not schizophrenic (Taft and Goldfarb, 1964). (Schizophrenia and other forms of mental illness will be described in Chapter 13.) This again is a correlational study in which it is impossible to

trace the direction of cause and effect. It is possible that, as this study suggests, birth difficulties predispose the child to schizophrenia.

nia. It is equally possible, however, that certain women are prone to have difficult deliveries and also to have schizophrenic children.

DEVELOPMENT DURING INFANCY

After 280 days of perfect comfort, with every need effortlessly satisfied, the human being suddenly finds himself propelled into a world where he must breathe to get his oxygen, suck to obtain his food, and cry vigorously to get a dry diaper. But the *neonate*, as the newborn infant is called, is well equipped to take this crisis in his stride. He is not quite so delicate as he may seem to the inexperienced mother who holds him in stiff, apprehensive arms when he is awake and checks often to see that he is still breathing when asleep. He is able to make most of his needs known, to make numerous movements on his own, and to begin to understand a little of the world around him. Although he is far from mature physically and has much to learn, he soon begins to make adjustive reactions to the physical and social world he lives in.

Physical Structure

At birth, the neonate is by no means a miniature adult physically. His head is about one fourth of his total body length, whereas in an adult it is one seventh. He has a bulging abdomen and narrow shoulders (the reverse of adult proportions) and relatively short legs. His muscles are small and soft, and his bones are composed mostly of cartilage. During the first years of life, while the infant's skeletal structure is growing toward adult proportions, the nervous system develops very rapidly, with the nerve cells increasing in size but not in number. Brain growth also is rapid, as we have seen; at birth

the brain is one fourth the size of the adult brain, at nine months one half, and by the end of the second year three fourths adult size.

Sensory Capability

What is the newborn infant capable of seeing, hearing, and feeling? Though his sense organs are well developed, it is unlikely that he possesses true consciousness. Probably, as William James expressed it classically, "the baby, assailed by eyes, ears, nose, skin, and entrails at once, feels it all as one great blooming, buzzing confusion." (James, 1890, p. 488) But although the infant probably cannot yet organize this confusion of sensations, he does show sensitivity to many kinds of stimulation. Testing sensory sensitivity in infants is difficult, however, because it must be inferred from a *response* of some sort. Where a response fails to occur, it may reflect immaturity of muscles rather than of sensory mechanisms.

Taste and smell. The sense of taste is well developed in the newborn infant, who usually reacts with sucking movements to sweet or salty stimuli and with negative behavior to sour or bitter ones.

Smell is another well-developed sense in the neonate. Definite changes in bodily activity and breathing rate following olfactory stimulation have been observed. The neonate responds in different degrees to acetic acid, asafetida, phenylethyl alcohol, and anise oil, although no clear differences are observed in response to

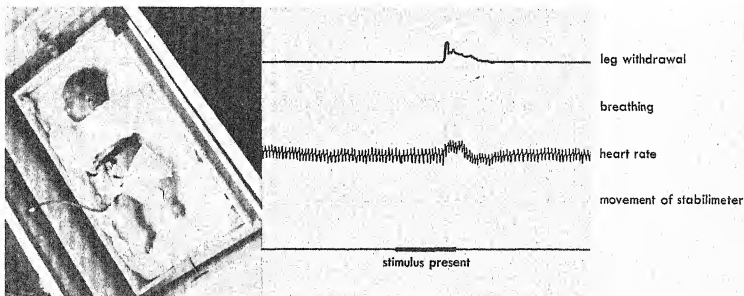
odors which are pleasant and unpleasant to the normal adult (Engen, Lipsitt, and Kaye, 1963).

Touch and temperature. Sensitivity to touch, pressure, and temperature is present at birth or shortly afterwards, with the face more sensitive than other parts of the body. The infant may refuse milk of the wrong temperature and also may respond to external temperature, usually reacting more strongly to cold than to heat. Sensitivity to pain is weak during the early days of life, being stronger on the face than elsewhere (as we might expect, knowing that the normal course of maturation is from the head downward). Circumcisions may therefore be performed without anesthetic during the first two weeks.

Hearing. Hearing seems to be less well developed than the other senses at birth, though

there is much variation from child to child. Hearing is at first hampered by amniotic fluid, which often remains in the middle ear for a few days after birth. Usually sometime between the third and the seventh day the neonate reacts to ordinary noises, responding more vigorously to the rattling of paper or dishes than to a voice. After the fourth week, however, he responds more frequently to voices than to loud noises.

Vision. Since the retina, the light-sensitive tissue of the eye, has not reached its full development at birth, it was formerly assumed that the neonate does not see clearly at first. Experiments have shown, however, that there is an innate ability to perceive form visually. In a recent study, it was found that infants under five days of age looked longer at black-and-white patterns than they did at plain colored surfaces. Infants a few days older were found to show even greater visual discrimination



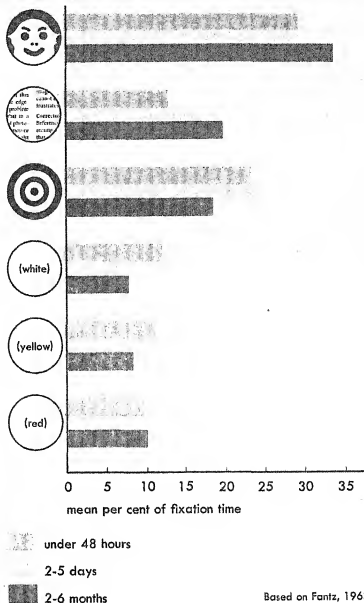
Based on Engen, Lipsitt, and Kaye, 1963

OLFACTORY SENSITIVITY IN NEWBORN INFANTS

- An infant's response to stimulation typically includes both overall body motions and specific skeletal and autonomic responses. To test early olfactory sensitivity, infants were placed in the stabilimeter pictured here and records were kept of leg withdrawal movements, breathing, heart rate, and movements of the stabilimeter itself both during and between presentations of olfactory stimuli. Not only were there clear responses to several odors, but the responses varied consistently for different odors. For example, the infants responded on almost every trial to acetic acid but on only about a fourth of the trials to phenylethyl alcohol.

PATTERN VISION IN INFANTS

The ability to differentiate between different visual stimuli is inferred from consistent differences in response to them. Babies under two days old and between two and five days old looked roughly three times as long at a black and white picture of a face as at a plain colored circle the same size. Older infants showed the same differential responses and the same order of preference between patterned and plain circles but showed more discrimination between the face and the concentric circles than the younger infants had shown.



Based on Fantz, 1963

(Fantz, 1963). • In another study, investigators showed newborn babies a series of pairs of shapes, each shape differing in the number of angles it contained. Shapes with ten angles or turns were preferred to other shapes with five turns or twenty turns, as inferred from photographic recordings of eye fixations (Hershenson, Munsinger, and Kessen, 1965). By about ten days after birth the infant can follow slowly moving objects with his eyes. Because his eye muscles are not well coordinated at first, he may occasionally look cross-eyed.

There is some disagreement as to whether the young infant perceives color. Recent experiments suggest that he does.

Stimuli varying in shape, color, or both were presented in pairs to infants four months of age. Preference (and hence ability to discriminate) was inferred from the amount of time spent in visual fixation. It was found that red and blue were significantly preferred to gray, but that shape dominated color as a basis for preference. A bullseye pattern was preferred to other patterns (Spears, 1964).

Responsive Capability

As early as the first day of life the neonate can yawn, hiccough, frown, lift his head slightly (this means that he can free his nose for breathing), make prancing movements with his

legs if supported at the armpits, and focus his eyes momentarily on a light. These accomplishments—together with the even more important sucking, swallowing, and other mouth movements involved in eating—are often called *general responses*, because they are responses to definite stimuli and in most cases involve the activity of rather large portions of the body. The infant also makes many more specific, automatic responses known as reflexes. These involve mainly a specific part of his body, although even they are accompanied by some total body activity. One of the most readily observed is the grasping reflex. ■ Other reflexes include the knee jerk, the pupillary reaction to light, blinking, and sneezing.

Because most responses continue to involve a large portion of the body for a time after birth, the human infant expends about two and a half times as much energy in proportion to body weight as does the adult.

From this vast amount of mass activity, specific movements are gradually differentiated. As in the case of the fetus, maturation in the neonate follows a definite sequence and continues to proceed from the head downward and from the center outward. Thus the eye and mouth movements come under control first, then those of the head and neck, later those of the trunk and arms, still later those of the hands and lower trunk, and finally those of the pelvic region, legs, and fingers (Shirley, 1931). The rate at which new achievements appear is also faster for the upper regions of the body. Thus some control of the eyes, head, neck, and arms is usually gained in rapid succession, with only a few days between each achievement. But after the baby begins to sit alone, it may take weeks or months before new abilities involving the lower portions of the body—such as creeping, standing, and walking—are added to his repertoire. The muscles involved in toilet training are among the last over which the child gains control; hence it is futile to expect a child to be “trained” before he is about two years old (Ilg and Ames, 1955). Too early or too rigid training may arouse undesirable emotional reactions in the child, who is not able to meet his parents’ strict expectations.

Every child develops at his own rate. Some walk at the age of nine months; others wait un-

til they are nearly twice that old. Although most babies succeed in “getting into everything” quite efficiently by creeping about on all fours, many skip this method of locomotion altogether and pull themselves along on their stomachs or even hitch themselves backward. Wide variations also exist in the development of less conspicuous achievements than walking, and it is useless to try to push children beyond their physical capacity.

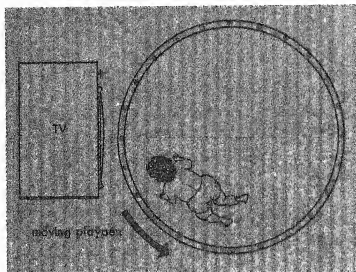
Transport movements of the whole body occur before there is maturation of specific manipulative movements.

A revolving playpen was used in an experiment in which thirty children between the ages of ten and twenty-eight months served as subjects. A closed-circuit TV monitor was placed outside the pen, which revolved



■ The strength of the grasping reflex of the neonate has never failed to impress the adult observer. There are two overlapping phases in the development of grasping in the newborn child (Halverson, 1937). The first is closure of the hand in response to light pressure on the palm. The second is gripping or clinging in response to stimulation of the tendons of the finger by pulling them. The closure reflex, which is so strong at birth, disappears in sixteen to twenty-four weeks; the gripping reflex remains longer. The grasp of the left hand may be slightly stronger than that of the right; but the right may show greater motility.

so that the child must crawl continuously in order to correct for the motion of the pen and continue to see the image on the screen, which was sometimes his mother and sometimes a stranger. The arrangement is depicted in the diagram below.



Records kept of the time spent observing the screen showed an increase in time spent looking at both the mother and the stranger with age of the child. The "most rapid developmental changes in orientation" to the TV screen occurred from the twentieth to the twenty-fourth month.

Other experiments involved visual and sound stimuli, including various images shown on a TV monitor and tape recordings of music, of parents' voices, and of the children's own voices. Nearly all infants below the age of twenty-two months, even infants only nine months old, oriented actively to both sound and visual images, turning or crawling toward them. However, none of them learned to touch a control plate on the side of the crib which would turn on the TV or start the music.

In another experiment, the child was placed in a crib with a rough floor which would be uncomfortable to his bare legs and hands. A blanket that could have been used to provide a softer surface hung on the side of the crib, but only one of five babies below the age of twenty-two months tried to use the blanket for protection, even after having it put into his lap.

The experimenters were unable to develop any devices which a child under twenty months of age would use to control his environment; in fact, they found purposeful manipulation to be very limited before the age of two years (Smith, Zwerg, and Smith, 1963).

The age of about twenty-two months appears to be a critical period in maturation, for at this

time the transition begins to be made from generalized control of the environment through motion of the entire body to more refined manipulative control.

Early Social Development

As he grows in size, makes more complex movements, and learns to coordinate his increasingly vivid perceptions, the infant develops a more and more active social life. From the moment of birth, he is a social creature, influenced by the affection of his mother or others who care for him. Certain ways of dealing with babies, such as leisurely, "cuddly" feedings, gradual and late weaning, and patient, unhurried toilet training, seem to be important to the formation of a healthy personality. Even more important, however, is the attitude of the parents toward the child, for this is responsible for most of the child's ideas and impressions about himself and his world.

Clinical findings with regard to the good effects of early mothering of human beings have been verified by numerous studies on lower animals.

In one such study, rats were handled daily ("mothered") from birth until weaning. A similar nonhandled group served as controls. A total of forty-four male rats, each from a different litter, was used. At the age of 100 days each rat was placed for ten minutes in the stem of a T-shaped apparatus. He could remain where he was, enter a "social" chamber containing another rat behind a wire fence, or enter a "novel" chamber containing three-dimensional wooden forms. Time spent in each chamber and amount of activity were recorded for four successive days. It was found that the handled rats were significantly more active and spent significantly more time than the nonhandled controls in the social and novel chambers (Denenberg and Grotz, 1964).

Speech Responses

Another important social development of infancy is the beginning of communication through speech. The infant begins to make language sounds during the first months after birth. His first vocalization is in the form of crying. All too often this sound is distressing to

the young mother. It should not be so, since high frequency and intensity of crying is predictive of normal or superior later speech and intelligence (Karelitz *et al.*, 1964). Careful study has shown that the "crybaby" is likely to be a bright baby, while the quiet, "good" baby is sometimes a brain-damaged or feeble-minded one.

Approximate vowel sounds are found in the babbling of young infants, but the only ones consistently used for the first two months are *e* as in *bet*, *i* as in *bit*, and *u* as in *but*. For the most part, the neonate uses vowels that are produced at the front of the mouth with the tongue in a relaxed position. It is much more difficult to produce back vowels, such as *oo* and *ah*, which require humping the back part of the tongue. The percentage of utterances of back vowels increases as the child matures. When he is about two and a half, the relative proportions of all vowel sounds used in his speech are about the same as found in adult speech (Irwin, 1948).

Many consonant sounds, particularly *m*, *n*, *g*, *h*, *w*, and *r*, are also noticeable in the infant's babbling. Some investigators have suggested that there may be a relationship between the number of different kinds of consonants ut-

tered during infancy and later intellectual status (Catalano and McCarthy, 1954). But whether or not this is true, certain consonant sounds are always later than others in developing. Until the baby has teeth, for example, it is impossible for him to use the *sibilants* (such as *z* and *s*); nor can he sound the *explosives* (such as *b* and *p*) until his muscles have become strong enough to supply the lip tension needed.

The babbling of the young infant is an extremely important process in learning to speak. By manipulating sounds and syllables, he exercises his lips, tongue, and breathing apparatus in various combinations and develops his vocal motor skill. All infants make the speech sounds found in all languages and accents, but as a child continues to develop through maturation and learning, sounds not used in his own language drop out and can be reacquired in adulthood only with great effort, as any mature person who has tried to learn to speak a foreign language can testify. Military personnel in combat frequently take advantage of this fact by using passwords that the enemy cannot pronounce. Thus a German soldier attempting to pronounce the password *Wyoming* would quickly give himself away by saying "vi-OH-ming."

THE INFLUENCE OF ENVIRONMENT

Even with good heredity, normal development does not come automatically to rats or men. Both before and after birth, hereditary potentialities can unfold only if the environment is favorable. For physical development, this means adequate food, water, warmth, and so on. The requirements for normal psychological development are not yet completely understood, but some of the available research will be presented here.

Although the newborn infant reacts to his environment, he is largely helpless in coping with it and needs a great deal of help from his

parents. This is only partly because he lacks knowledge of his new environment. As we have seen, adequate adjustive behavior must also await adequate maturation, and no amount of exposure to the environment will enable the infant to make effective adjustments as long as he remains immature physically.

The Effects of an Impoverished Environment

Although a child's behavioral development into a capable adult remains closely associated

with maturational processes, an impoverished environment can lead to delayed or inadequate development in spite of adequate hereditary potentialities.

Restricted environment in infancy. Sometimes society performs a "natural experiment." That is, a particular group of people may be exposed to unusual conditions because society has no better resources for dealing with them. The effects of differences between such special conditions in infancy and the more usual conditions of a home environment are brought out clearly in a recent study comparing home-reared children with children brought up in the environment of an institution until the age of eighteen months and then moved to families.

Institutionalized infants placed in homes between the ages of eighteen months and two years showed great improvement in many ways. Among the most noticeable early improvements was the change in their appearance. They looked healthier and happier—as one mother expressed it, "He has blossomed." They became more active and got more enjoyment from contacts with other people. Many also caused their foster parents a little trouble by becoming much more aggressive in demanding their own way, whereas they had at first been passively obedient. However, this self-assertive behavior was really a sign of greater emotional health. They were quick to learn how to feed and dress themselves.

On specific tests the children did well on imitative tasks such as block building, repeating words, etc. Their gross motor development was adequate, on the whole, but they were never quite so graceful in their movements as the children reared in homes from the beginning.

Language proved the area of greatest retardation for the group that had been institutionalized. At an age when the child asks questions constantly, they did so to a much lesser extent than the children reared at home. Also, they seemed to find it difficult to express ideas and fantasies or to verbalize their feelings. This retardation would appear to be closely related to the impaired thinking ability they evidenced in various ways. They found it difficult to make generalizations or to develop abstract concepts. Also it was hard for them to think through a situation and to solve problems which involved overcoming obstacles. In their play they showed less imagination than the home-reared group.

Certain differences appeared in their relations with people. It was rare for a child who had been in the

institution as long as eighteen months to turn to an adult for help in solving any problem, whereas this was characteristic of the home-reared children, who also turned to adults for comfort if frustrated. The institutionalized child, on the other hand, if unable to solve a problem, usually went off and left the task as if indifferent to it. Or, if it was a particularly interesting problem with an attractive reward—candy or the like—to be gained by its solution, the child would try harder for a time but if not successful would cry or go into a corner alone rather than turn to an adult. Even after months of living with his foster mother, he did not seek comfort from her nearly as much as did the family children. This attitude appeared to be related to a general tendency to be indiscriminately friendly to other people, forming many superficial relationships rather than a few deep ones.

The institutionalized children showed less control of their impulses than the family children and were less able to defer the gratification of their desires. Furthermore, they showed less flexibility in adapting to new situations than did the home-reared children (Provence and Lipton, 1963).

One well-controlled natural experiment dealt with adolescents who had spent their infancy in institutions.

The subjects of this investigation were fifteen adolescents, aged ten to fourteen, who had been placed under institutional care at about the age of four months and had remained in institutions for about three years. They had then been placed in foster homes. These children were equated as to age and sex with members of a control group. The controls were also foster children, but they had gone directly to the foster homes from their own homes, while still under two years of age, and had spent no time under institutional care. The foster homes were of similar economic and cultural status in both groups, and the children had made about equal adjustments to the homes.

When the adolescents who spent their infancy in institutions were compared with those who had always lived in homes, striking differences were noted. On intelligence tests 100 per cent of the institutionalized group made below-average total scores, as compared to only 40 per cent of the family children. Important personality differences were also noted. Members of the institutionalized group tended to be apathetic, unambitious, and lacking in a clear sense of personal identity.

They were less responsive to approval, less thoughtful in problem solving, less mature socially, less stimulated by competition, and less capable of sustained effort. In spite of having spent several years in a family environment, they were retarded in language and speech development. Most of them were unable to form satisfying relationships with other people and thus suffered from feelings of personal insecurity (Goldfarb, 1943).

The deprivations these adolescents had experienced during infancy apparently had left lasting effects that were not overcome by the experience of relatively normal home life in later years.

Sensory restriction in a normal environment. Occasionally a specific form of sensory restriction may occur in an apparently normal environment.

Seven-year-old James was referred to a psychological clinic because of difficulties in school. He had not learned as rapidly as most children in the first grade and had appeared inattentive. Nor had he made a good social adjustment. His hearing was examined and found to be normal, but on some of the tests he showed characteristics of a hard-of-hearing child. For example, he could not tell where sounds came from and could not readily understand words out of context.

His history revealed that during the first three years of his life James had had middle ear infections which had been evidenced by inattentiveness and retarded speech development. The cause of the infections was discovered and eliminated, and James' hearing was normal from that time on. But his inattentiveness persisted, increasing when he was in a stressful situation. Although his speech development had progressed normally after the age of three, it was noticed that he hesitated slightly before answering a question, as if translating the words into some more meaningful form. Deprivation of adequate sound stimuli at the crucial stage in development when the child learns to pay attention to the speech of others and to respond had handicapped him not only in developing an adequate vocabulary but also in acquiring the proper basic attitudes toward interpersonal communication. Thus his social adjustment, as well as his learning ability, was lowered (Eisen, 1962).

The effects of visual deprivation throughout early life have been studied in adults who were

born blind because of cataracts of the lens and who, upon having the cataracts surgically removed, were suddenly able to see for the first time. To understand just how these persons were handicapped in their visual perception of objects, it is important to distinguish between *figural unity* and *figural identity*. When a person can see that the figure stands out from its background and realizes that it is an object, he is said to perceive *figural unity*. However, to perceive its *identity* he must also recognize it as belonging to a certain class of figures. At the very least he must realize that it is different from some other figure or perhaps that it is like a figure he has seen before, even if he cannot go so far as to recognize it as a square or a circle. The patients studied could readily perceive *figural unity* but required long, difficult training in order to perceive *figural identity*.

"Investigators [of vision following operation for congenital cataract] are unanimous in reporting that the perception of a square, circle, or triangle, or of a sphere or cube, is very poor. To see one of these as a whole object, with distinctive characteristics immediately evident, is not possible for a long period. The most intelligent and best-motivated patient has to seek corners painstakingly even to distinguish a triangle from a circle. The newly seeing patient can frequently find a difference between two such figures shown together . . . but the differences are not remembered. There is for weeks practically zero capacity to learn names for such figures, even when actual recognition is prompt and complete." (Hebb, 1949, p. 28)

It was also difficult for the patients to generalize their hard-won knowledge and recognize objects in what seemed only a slightly different context. That is, although they could identify a lump of sugar in the examiner's hand, they failed to recognize it if it was suspended from a string. Motivation as a factor in their learning was ruled out by the fact that they experienced just as much difficulty in identifying the faces of friends, relatives and other persons of great importance in their lives as they did in identifying geometric figures. One exceptionally intelligent patient could identify only four or five faces two years after the operation. Of course certain physical factors interfered with vision immediately after such an operation—dazzle, eye-muscle cramp and some narrowing of the visual field. However, it is unlikely that these effects would persist long enough to account for a very large proportion of the difficulties the

patients experienced. Their early visual deprivation handicapped them in later visual perception, although it did not cause physical deterioration of the eyes, since the patients were eventually able to identify visual objects normally (Senden, 1932, as cited in Hebb, 1949).

Restricted environment for lower animals. Obviously, studies of the effects of restricted environment upon the development of lower animals can be far better controlled than can those on human beings. Some of the outstanding studies in this area will be reviewed here.

Having studied the reports of the cataract patients described above, one investigator sought to duplicate, using a chimpanzee, the conditions under which these persons had been reared. He therefore raised the chimpanzee in complete darkness. In this case, however, some actual degeneration of the tissues of the retina occurred. This had not happened in the case of the cataract patients because cataracts, although preventing pattern vision, do not completely eliminate light from the retina, and its structures develop normally. With this factor controlled, a second experiment yielded results quite similar to those obtained with the human patients (Riesen, 1950).



▲ Rob, deprived of sensory stimulation to his hands for many months, permanently lost the capacity to learn to respond appropriately to such stimulation.

Later studies have demonstrated with kittens and chimpanzees that where visual deprivation leads to chemical changes in the retina, such changes become irreversible when the deprivation is continued beyond infancy, with the result that the animals suffer a permanent inability to learn certain perceptual habits (Riesen, 1961).

The results of tactual deprivation have also been studied with a chimpanzee.

The subject, Rob, had his limbs from elbow to fingertips and from knee to toes encased in cardboard tubes from the age of four weeks to thirty-one months. ▲ Rob never learned to turn his head toward the hand which the experimenter stimulated. That is, if the experimenter squeezed his right hand, Rob was to turn his head to the right in order to receive a reward. After 2000 trials he was unable to do this, although a normal chimpanzee learned the task in about 200 trials (Nissen, Chow, and Semmes, 1951).

While only a limited number of subjects were used in such experiments on chimpanzees, the results would appear to indicate that specific sensory deprivation in infancy has deleterious effects on performance later in life.

A series of experiments on a broader scale conducted at McGill University in Canada has shown that the behavior of dogs raised under restricted conditions is inferior to that of unrestricted dogs in a number of important respects.

In the first of these studies three male Scotch terrier puppies were raised for seven and a half months in a cage. Although the cage was lighted, the dogs could not see out and had no contact with human beings except at feeding time. Three litter mates of the restricted puppies were raised as pets.

When the restricted puppies were released at the end of the seven and a half months, they were much more active in familiar situations than were their litter mates who had been raised under "normal" conditions. In most unfamiliar situations they tended to continue exploratory activity longer, but in some new situations they showed a peculiar "freezing" behavior. If placed in cages for the night, the restricted animals tended to withdraw into a corner when the examiner came to release them. Those raised as pets, on the other hand, were eager to get out. Although some of this peculiar behavior soon disappeared, traces of it remained after

six months and the tendency to be excessively active lasted for over a year (Clarke, Heron, Fetherstonhaugh, Forgays, and Hebb, 1951).

Other studies of restriction have added to these findings. One such study investigated the effects of early restriction on problem-solving ability. The restricted dogs showed inferior ability on every type of test used. Throughout the experiment, they showed a lack of ability to discriminate the relevant aspects of the situation and to adapt to changes in the environment. Their ability to pay attention also seemed to be impaired. The experimenter concluded that in the case of dogs, at least, early deprivation seems to have "a definite and fairly permanent retarding effect" on ability to learn in later life (Thompson and Heron, 1954a, 1954b).

Another study with dogs showed that restricting young animals also retards their emotional development, and that a long period of "well-organized experience of the environment in which emotion-provoking objects will appear is necessary for the emergence of adaptive emotional behavior. . . ." (Melzack, 1954)

A further study found that dogs deprived of normal stimuli in infancy were virtually incapable of learning to avoid painful stimuli later and therefore could not be taught to fear objects associated with such stimuli.

Ten dogs reared in isolation for eight months were compared with twelve litter mates in tests given three to five weeks after they were released and given normal stimulation. Response to electric shock was tested with a toy car which could be maneuvered by hand and was connected with a shock source. The experimenter tried to hit the dog with the car ten times during a testing period; if the dog avoided the car five times in a row, testing was discontinued for that period.

In four sessions the restricted animals received a mean of 24.7 shocks, as compared to a mean of only 6 for the normal dogs. All unrestricted dogs had achieved five successive avoidances by the end of the fourth testing period, but only three of the seven restricted dogs had done so, and two of them had received all 40 shocks, showing no signs of learning to avoid the car. Normal dogs, though excited at first, soon showed little excitement and made smooth, precise movements in avoiding the car. Restricted dogs, however, showed wild, aimless activity, often running in circles or trying to climb out of the enclosure. After two years, two of these dogs still showed the same exaggerated behavior.

In other tests, restricted dogs did not even show normal avoidance of pain. When the experimenter tried to touch a burning match to his nose, the restricted dog, in seven out of ten cases, made no attempt to turn his head but actually poked his nose into the flame. Only three dogs squealed on making contact with the flame and tried to avoid it afterwards by moving their heads. There was no evidence that the dogs felt pain from the flame. They showed similar lack of sensitivity to pain when pricked with needles, or when their wild movements resulted in severe bumps as they dashed about the laboratory. This lack of sensitivity suggests changes in the pain receptors as a result of the deprivation of stimulation (Melzack and Scott, 1957).

A number of studies have shown that early social contact may be essential for the development of normal sexual patterns in adulthood.

One study found that an adequate sexual behavior pattern emerged in male rats even in the absence of any opportunity to learn, but that early social contact with litter mates clearly improved sexual performance later (Zimbardo, 1958).

In another study, rhesus monkeys reared in isolation never developed normal adult patterns, whereas monkeys separated from their mothers at birth but allowed to play with other infant monkeys developed the sexual behavior typical of their species (Harlow, 1962).

In a recent study of the effects of early social deprivation on subsequent maternal behavior in rhesus monkeys, it was found that after total lack of contact with other animals during the first year and a half of life, adult females showed severe deficiencies in maternal behavior. They ignored, withdrew from, and even physically abused their first-born infants. However, their behavior with second infants appeared normal, even overprotective. The reason for this is not clear. The infants that had been rejected and abused showed no permanent impairment of their social adjustment. The opportunity for social relationships with relatively normal monkeys seemed to compensate for the inadequate mothering they had received (Seay, Alexander, and Harlow, 1964).

A series of studies of mother-infant behavior in monkeys also indicates that adequate mothering alone is not enough to ensure normal development.

Mother-infant pairs of monkeys were observed under two different conditions. Some were placed in a privation environment, which consisted of a soundproof room in a barren cage with no climbing facilities and no access to other animals or people. Others enjoyed a rich environment with varied stimuli, including many toys to manipulate or play on. Both animals and people could be seen and heard by these pairs.

A primary effect of the restricted environment was an overattachment of mother and infant. Tabulation of the animals' behavior showed much greater interaction between mother and infant than in the more enriched surroundings. The mothers in the restricted environment often held on to their infants when the latter tried to leave and explore on their own. These mothers also engaged in more punishing behavior. Thus there was interference with the normal process of gaining independence from the mother, without which normal adult social life is impossible (Jensen and Bobbitt, 1964).

The Effects of an Enriched Environment

Evidence has accumulated in recent years that certain types of stimulation, especially in early life, can not only hasten development but result in a higher final level than would otherwise have been achieved. Studies of both animal and human development support these conclusions.

The effects of early stimulation. We have seen that early handling makes rats more active. Baby rats handled ten minutes a day also are found to grow faster and to be heavier than litter mates that do not receive such stimulation. They also show more flexibility in adapting to novel situations and better adaptability to stress (Weininger, McClelland, and Arima, 1954). Mice handled in infancy show much less emotion when presented with novel stimuli than do mice not handled in infancy (Levine, 1959).

Ability to solve maze problems is heightened by an enriched early environment.

In one experiment using rats as subjects, Group 1 lived for six weeks in a "free environment" box containing blind alleys, runways, and objects which they could both see and manipulate. Group 2 lived in small mesh cages which were moved each day to a different loca-

tion in the laboratory, six of the locations being within the free environment box. Thus these animals had rich visual experience but could not explore runways or manipulate objects. Group 3 lived in small stovepipes, which limited both movement and visual stimulation. Group 4 were kept in enclosed activity wheels so that they were highly active but had as limited a visual environment as Group 3. When the rats were given "intelligence tests" on the specially designed maze problems, Groups 1 and 2 did about the same—and much better than Groups 3 and 4, which also did about the same. Evidently the development of maze-learning ability was more dependent on visual experience than on motor activity.

Using similar equipment the same investigator showed that free-environment experience early in life was much more beneficial than the same experience somewhat later (Hymovitch, 1952).

Exposure to specific stimuli at an early age can also affect later performance. For example, rats raised in cages containing four wall plaques—two triangles and two circles—performed much better on a learning task which required them to discriminate between these two geometric forms than did rats raised in plain white cages (Gibson and Walk, 1956). In a later experiment, rats exposed early to an equilateral triangle and a circle did much better than control rats in discriminating between an isosceles triangle and an ellipse, showing that their knowledge carried over to similar figures (Gibson *et al.*, 1958).

In a study with human subjects, 308 East African (Uganda) children, most of them below the age of two years, were tested for strength and motor coordination and compared to Western children on the basis of criteria standardized by Gesell at Yale University. A year later, 51 of the Uganda children were retested.

The Uganda babies, some of whom are shown in the pictures on page 100, were found to be noticeably superior to Western babies of the same ages, and from the fifth month also showed precocity in adaptivity, language, and personal-social relationships. Most of the African children studied came from lower-class families which still follow the ancient child-rearing practices of their culture. The typical mother-child relationship before weaning is one of complete solicitude, involving companionship during the night as well as the day; feeding according to the demand of the child; constant

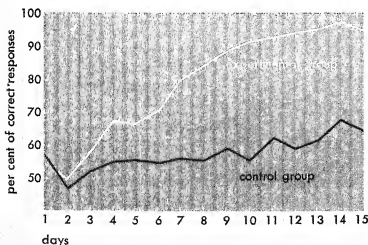
external stimulation such as cuddling, tickling, and soft words; and interest and help in motor tasks. Indeed, even before birth, the mother's sole interest is in her coming child. Because it is generally believed by these Africans that any unhappy thoughts of the mother may adversely affect the future of the new baby, every attempt is made to prevent the occurrence of any emotional upsets during pregnancy. Thus the environment is favorable before as well as after birth. Those few children studied who came from the higher classes, whose families had become somewhat Westernized,

tended to show considerably less precocity (Geber, 1958).

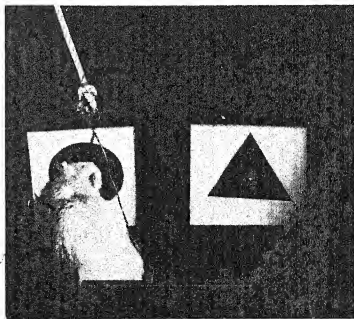
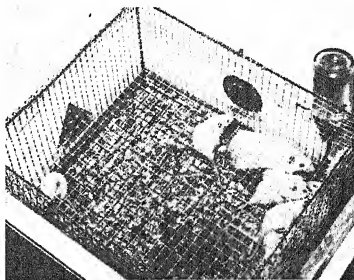
The effects of opportunity for practice. We have already seen that considerable practice is necessary for the development of proficiency even in some activities regarded as instinctive. We have also seen that in early life the effects of a given amount of practice vary with the maturational level of the individual. Up to a critical maturational level, less and less practice may

EARLY EXPERIENCE CAN IMPROVE LATER LEARNING

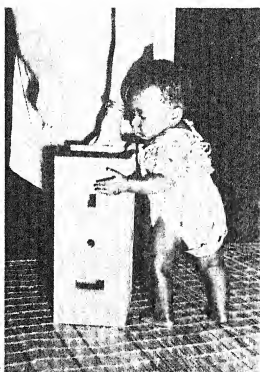
The experimental group was raised in a cage with geometric forms on the walls (right), but nothing in particular was done to call their attention to the forms. Living and training conditions were the same for the control group except that no forms were put on the walls of their cage. Later, both groups were given tasks involving discrimination of geometric forms (below, right). If they chose the correct form, they received food. The learning curves (below, left) show the percentage of correct responses per day for the two groups. Interestingly, a later study replicated the effect of the cut-out forms, as used here, but found no such effect with printed forms.



Based on Gibson and Walk, 1956



Uganda infants develop motor coordination much earlier than do Western children. A child nine hours old (top left), when drawn up to a sitting position, is able to prevent his head from falling backward, a feat not accomplished by the Western child until the age of six weeks. At two days (top right) the African child holds his head firmly and, with his eyes focused, looks at the examiner; not until eight weeks is this done by the average Western child. A seven-week-old Uganda infant (bottom left) can support himself in a sitting position while watching his reflection in a mirror in a manner comparable to that of a Western child of twenty weeks. At five months, as compared to nine months for the Western child, the Uganda child is able to hold himself upright. He can even take the forms from a Gesell testing board (bottom center); this is done in the West only at eleven months. At seven months, a Uganda child walks to the Gesell box to look inside (bottom right); an average Western child does this at about fifteen months.



be needed to achieve a given degree of proficiency. Beyond that point, learning may again become more difficult, and more practice may be needed. This interweaving of the influences of heredity and environment continues throughout life.

What happens if large amounts of practice are given after maturational readiness has been reached? Do people given the same amount of intensive practice become more alike or more different in ability?

In a classic experiment, groups of college students, 114 to 200 in each group, were given practice in one of four tasks—canceling all the A's on a page, learning a symbol-digit code, learning vocabulary, or underlining all of the four-letter English words "hidden" in a page of jumbled type. All subjects improved with practice, but instead of becoming more alike, as might have been expected, the initial differences between high and low scorers increased for all four tasks. ♦ Also, there was a strong tendency for individual subjects to maintain the same relative standing in the group throughout the practice period. The top-ranking individual on the first trial usually came out on top on the last trial, while the lowest scorer on the first trial tended to make the lowest score on the last trial also (Anastasi, 1934).

A more recent study, also using college students as subjects, has confirmed these findings (Noble, 1959).

Such an increase in individual differences among people given the same intensive practice indicates persisting differences among them in ability to profit from practice. These differences probably reflect hereditary limitations in some cases; in other cases different approaches, attitudes, or previous learning may be responsible.

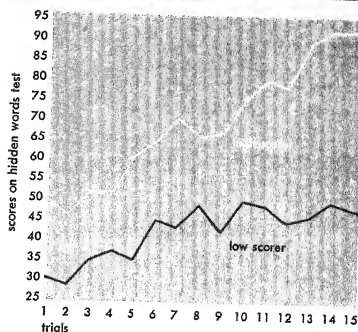
Developmental Tasks

Important as maturation is in setting a timetable for the unfolding of human capacities, the actual skills people learn and their attitudes toward people and society depend also on the demands made by the environment. Each cultural environment has a unique pattern of requirements to be met by those who grow up in it.

At each period in life there are particular kinds of tasks for each individual to perform, imposed on him by his society and by his own

♦ PRACTICE INCREASES INDIVIDUAL DIFFERENCES

These are the learning curves of a high scorer and a low scorer on the hidden words test. The difference between their scores, already large on the first trial, increases considerably by the last trial; the two curves never cross or come closer together.



Based on Anastasi, 1934

needs and made possible of solution by past learning and the continuing process of maturation (Havighurst, 1952). For example, both environmental pressures and his own growth forces are active in pushing a child toward learning to walk and talk. Walking and talking are "developmental tasks" of all young children, and the success with which these and other tasks are achieved has a great influence both on the individual's general adjustment and happiness and on his success in achieving subsequent tasks. The principal developmental tasks for each stage of development in our society are shown in the chart on p. 102 (Havighurst, 1953).

Specific developmental tasks vary greatly, of course, from one culture to another. Although children in all cultures learn to walk and talk, not all learn to sit cross-legged, to be deferential in the presence of adults, to read printed characters, or to recognize animal tracks. The members of each society are presented with a unique pattern of developmental tasks.

DEVELOPMENTAL TASKS FROM INFANCY THROUGH LATER MATURITY

Infancy and Early Childhood (birth to 6 years)	Middle Childhood (6-12 years)	Adolescence (12-18 years)
<ul style="list-style-type: none"> Learning to walk Learning to take solid foods Learning to talk Learning to control the elimination of body wastes Learning sex differences and sexual modesty Achieving physiological stability Forming simple concepts of social and physical reality Learning to relate oneself emotionally to parents, siblings, and other people Learning to distinguish right and wrong and developing a conscience 	<ul style="list-style-type: none"> Learning physical skills necessary for ordinary games Building wholesome attitudes toward oneself as a growing organism Learning to get along with age-mates Learning an appropriate sex role Developing fundamental skills in reading, writing, and calculating Developing concepts necessary for everyday living Developing conscience, morality, and a scale of values Developing attitudes toward social groups and institutions 	<ul style="list-style-type: none"> Accepting one's physique and accepting a masculine or feminine role New relations with age-mates of both sexes Emotional independence of parents and other adults Achieving assurance of economic independence Selecting and preparing for an occupation Developing intellectual skills and concepts necessary for civic competence Desiring and achieving socially responsible behavior Preparing for marriage and family life Building conscious values in harmony with an adequate scientific world-picture
Early Adulthood (18-35 years)	Middle Age (35-60 years)	Later Maturity (60+)
<ul style="list-style-type: none"> Selecting a mate Learning to live with a marriage partner Starting a family Rearing children Managing a home Getting started in an occupation Taking on civic responsibility Finding a congenial social group 	<ul style="list-style-type: none"> Achieving adult civic and social responsibility Establishing and maintaining an economic standard of living Assisting teen-age children to become responsible and happy adults Developing adult leisure-time activities Relating oneself to one's spouse as a person Accepting and adjusting to the physiological changes of middle age Adjusting to aging parents 	<ul style="list-style-type: none"> Adjusting to decreasing physical strength and health Adjusting to retirement and reduced income Adjusting to death of spouse Establishing an explicit affiliation with one's age group Meeting social and civic obligations Establishing satisfactory physical living arrangements

Based on Havighurst, 1953

What adults praise in their children is a good measure of the demands of their particular society and hence of the developmental tasks their children face.

A revealing study of the behavior praised by different cultural groups was made with children aged five to

eleven years living in Beirut, Lebanon—120 Americans, 240 Arabs, 60 Armenians, and 60 Jews. These children were interviewed and asked to tell of two recent incidents when they had been praised and what the praise had been given for. The table shows the percentage of youngsters indicating praise for each type of behavior listed. American children were praised most often for

DIFFERENT DEFINITIONS CREATE DIFFERENT DEVELOPMENTAL TASKS

Aspect of Life	Typical Middle-Class View	Typical Lower-Class View
Authority (courts, police, school officials)	A source of security, to be supported and appealed to	Enemies, to be hated and avoided
Education	A means of success and upward mobility	Something to endure till children can go to work
Goal in life	Material success, social acceptance	"Coolness"; to get by without attracting notice of authorities
The future	Something to look forward to	Non-existent; one lives each moment fully and fatalistically
View of self	Self-acceptance	Self-hatred or bristling defensiveness
Society as a whole	Something to identify with and conform to	Something to be resisted and suspected
Delinquency	An evil originating outside the middle-class home	An inevitable fact of life, to be ignored unless police are involved
One's home	Something to own and cherish	A way-station to nowhere
The street	Paved path for one's auto	An escape from crowded living quarters
Violence	Last resort for authorities	A cathartic; a tool for living and getting on
Sex	Binding force for family, source of adventure, factor in family planning	A release; one of few pleasures without present cost
Money and possessions	To be saved and used wisely with careful planning	To be used now before they disappear

Adapted from Segalman, 1965,
by courtesy of Ralph Segalman, Texas Western College

helping their mothers, at least according to the report of the children. Children in the other groups indicated that they were praised most often for good schoolwork (Dennis, 1957).

American Arab Armenian Jewish

	American	Arab	Armenian	Jewish
Schoolwork	5%	28%	31%	41%
Helping mother	25	26	15	22
Helping father	6	2	0	2
Helping sibling	9	4	3	5
Helping relatives	0	2	3	0
Helping unfortunate	0	9	12	3
Helping peers	8	0	1	2
Helping others	7	5	3	3
Being quiet	1	3	5	2
Being polite, obedient	5	11	7	7
Sports and games	6	2	3	2
Giving or sharing	9	2	8	3
Creative work	13	2	8	3
Miscellaneous	6	5	4	7

Although children in different societies face widely differing developmental tasks, they all learn early that certain traits are valued and others held in low esteem by those around them and that at each age they face definite expectations. Whatever the specific tasks, success in early ones is usually necessary if the individual is to be equipped to meet later ones successfully.

Children growing up in different strata of the same society face quite different expectations on the part of those around them. This fact is sometimes ignored by psychologists, psychiatrists, teachers, and social workers, who as a rule come from the upper middle class and have had limited contacts with the poor and underprivileged of all ethnic origins. Thus a child who is regarded as troublesome and "unmotivated" by his teacher may be showing alacrity and success in adapting to the expectations of his family and friends. Strikingly different viewpoints toward several aspects of society are summarized in the chart.

THE GROWTH AND DECLINE OF HUMAN ABILITIES

Under the joint influence of heredity and environment, human abilities reach their peak fairly early in life, hold fairly level over a span of twenty to thirty years, and then start to decline. However, many exceptional individuals have made brilliant intellectual contributions while in their seventies or eighties. In our government the Supreme Court justices command high respect and wield great power. Surely the intelligence of older persons such as these has not decreased markedly. Are they rare exceptions to a general rule of decline, or is the apparent intellectual deterioration of many elderly persons actually a decline in physical functions, visual acuity, and the like? Or, since our society on the whole offers its older people no useful role, do we lessen their ability by offering them less opportunity for intellectual activity? These are important questions since the human life span, thanks to an abundant economy and the excellence of our public health programs and private medical practice, is continually lengthening.

The Prime of Life

Actually there is no one prime of life. The exact age at which maximum development is attained depends upon the nature of the task under consideration. Simple performances attain their maximum early in life; complex ones grow more slowly. A young child walks about as well as he ever will, but his ability to talk (as measured by the size of his vocabulary) will increase fairly steadily until middle age. Many skills that are complex and can be improved with practice seem to develop to their fullest in the mid-twenties, which is the prime of life for most types of motor performances. ♦

That maximum proficiency in various skills develops at different ages has been clearly demonstrated by a study of several thousand outstanding performers in a number of athletic activities (Lehman, 1951). The chart summarizes some of the findings of this study.

Type of Performance	Ages of Maximum Proficiency
Professional football	23-27
Professional ice hockey	24-28
Professional tennis	25-29
Championship rifle and pistol shooting	25-29
Championship billiards	25-29
Professional baseball (hitting)	26-29
Heavyweight boxing	26-30
Professional baseball (pitching)	26-31
Championship golf (open)	27-31
Championship cornhusking	27-31
Bowling	30-34

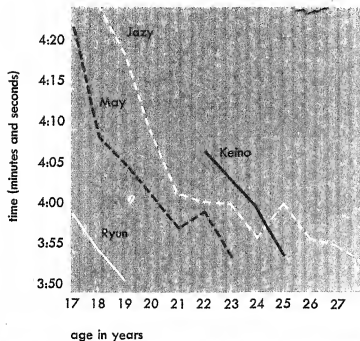
It is important to note that only outstanding performers, many of them champions, were considered in this study. The reason for limiting the study to performers who displayed a high degree of skill is that few people ever actually reach the very peak of performance within the bounds of their capacity. Most human beings are content to rest at some point below their maximum potential performance, whereas athletic champions attain an exceptional level of performance not only because they have great innate capacity but also because of an enormous amount of practice. It is only among champions that we see an individual's capacity expressed to the maximum possible for him.

There is also evidence that in some types of intellectual creativity the greatest achievement may occur early in life. Among chemists and physicists, for example, most master works (mentioned ten or more times in histories of the fields) are produced between the ages of 25 and 29, with lesser works produced five years later (Lehman, 1964).

Methods of Studying Growth and Decline

In studying the growth and decline of human abilities, two basic methods are used—the *cross-sectional* and the *longitudinal*. Each has advantages and disadvantages.

The cross-sectional approach. In cross-sectional studies, subjects are grouped according to age. This method makes it possible to use one set of tests with a wide enough range of difficulty to permit testing young, middle-aged, and old subjects. There remains, of course, the problem (also encountered in the longitudinal method) of obtaining tests that are equally fair to all age groups. Older persons are further from their school days than younger ones and have had more opportunity to forget. Thus, since most intelligence tests correlate highly with school learning, the older subjects are penalized. Another difficulty involved in making tests equally fair for all age groups is that of controlling the content for cultural changes. For example,

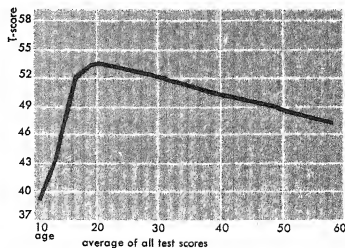


MATURATION AND PRACTICE IN ATHLETIC SKILL

This graph shows the improvements in running time of four of today's best milers. Even under conditions of maximum practice, maturation will ultimately set a limit to the top performance of all of them, but most experts expect Ryun to surpass the other three because he is performing better than they did at his age and most milers do not reach their peak till their late twenties. Thus at nineteen he presumably still has approximately ten more years in which further maturation of his neuromuscular system will be occurring.

GROWTH AND DECLINE OF MENTAL ABILITIES

This combined, smoothed curve shows the growth and decline of the mental abilities of the rural New England sample studied by Jones and Conrad (1933), as measured by the Army Alpha Test, an early intelligence test developed for use in the army during World War I.



grandfather is more likely than grandson to be able to answer this item, taken from the famous Army Alpha group examination of World War I: "Carrie Chapman Catt is known as a: singer, writer, nurse, suffragist."

One of the most important difficulties in cross-sectional studies is that of sampling the population at various ages in such a way that each sample is representative of all individuals of the same age. Obviously school populations cannot be used exclusively, especially after the age of compulsory attendance. It is well established that the less able students lag behind their classes and tend to drop out earlier than the more able. The higher the grade level, the stronger is the action of this selective factor. The best studies employing the cross-sectional approach have used subjects reached outside of the schools.

The results of one of the earlier studies of this nature, in which practically all the inhabitants of a New England village between the ages of ten and sixty were tested, are shown in the diagram. The village was chosen for its great stability of population, few leaving and few coming from the outside. Of course, even in a situation

of this sort, the age of death exerts a selective influence since those of lower ability tend to die younger than those of higher ability.

The investigators found that mental abilities grew in a fairly regular manner until the subjects were around eighteen years of age and that most abilities reached their peak between the ages of eighteen and twenty-one. Vocabulary and general information, however, grew until somewhere in the middle forties and declined more slowly than other measured abilities (Jones and Conrad, 1933).

Another difficulty in the cross-sectional approach is that it is very hard to equate the factor of motivation for the various age groups. Older people tend to feel that they already know as much as they need to know and hence are not likely to work as hard as the younger subjects, who are still under the influence of school discipline. When the subjects are chosen on a volunteer basis, this motivation factor is particularly important, since the refusal of some subjects to take the test may make it impossible to obtain a true cross section of the population.

Reasoning, that previous studies might have used inadequate samples of the population, since not all older people are willing to be tested, two investigators conducted a study on a prison population, where forced testing was possible and comparable motivation could be assured. They used an individual scale instead of the group tests which had usually been used in previous studies.

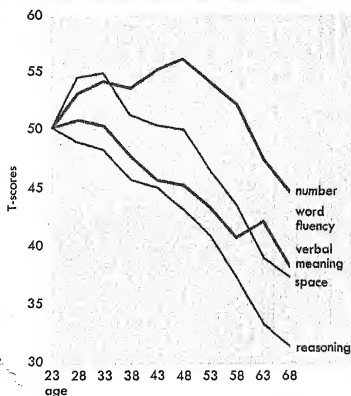
The total scores declined with age, but surprising differences were noted in the various subtests. On the verbal material, the inmates actually showed an increase of 9 per cent from age fifteen to age seventy. Performance tasks calling for visual acuity, space visualization, and motor dexterity showed the fastest rate of decline.

The general conclusions were that test scores of older people will vary in a downward direction if the tests contain visual and motor factors but in an upward direction if the tests contain material which depends on continued learning, such as vocabulary or information items (Corsini and Fossett, 1953).

This study supports the hypothesis that intelligence as a whole does not decline sharply with age. Its results would be weakened, of course, if it were shown that being convicted of a crime is

AGE AND TEST PERFORMANCE

These curves show a decreasing performance with age on the five primary abilities tested by the SRA Primary Mental Abilities Test. The figures have been adjusted so that the mean of the youngest group is the base. Note that three of the abilities improve after the age of twenty and remain above the early level during most of the active adult period. The reasoning test is an artificial task seldom encountered in everyday life; also it is sharply speeded, in contrast to the verbal test. Both these factors tend to penalize the older subjects.



Based on Schaie, 1958

a selective factor—that the prison population is not, in fact, representative of the general population in respect to mental abilities.

On the other hand, comparable results have been obtained in a more recent experiment using a broader group of subjects (Schaie, 1958).

The longitudinal approach. In cross-sectional investigations it is impossible to determine exactly the initial abilities of all the subjects—to be certain what scores the middle-aged and old-

er people, for example, would have obtained at the age of ten or twenty or thirty. Thus we can never be sure that the groups selected for the study are fairly equated with one another.

The longitudinal method overcomes this difficulty by testing the same individuals at intervals during their lives. Such studies have seldom been attempted, however, for the practical difficulties are enormous. In the first place, an elaborate and permanent research organization is necessary to standardize methods of gathering and analyzing the data and to make sure that the standards are adhered to in each successive measurement. Another problem is that of keeping track of individuals as they move from place to place. The longitudinal method also requires numerous forms of whatever test is used so that the practice effect from previous testings does not obscure the effect of age itself. Alternate test forms must be equated for difficulty and must contain similar but not identical materials.

Longitudinal studies of adults have been few and fragmentary, and a longitudinal study over the entire life span has never been conducted. The early years of life, however, have been studied in this way. In one such study, which covered a twenty-five-year span, 111 subjects were tested at preschool age, in adolescence, and again in adulthood. Results indicated that mental growth continues after the age of sixteen, with males showing somewhat more increase than females. Growth after adolescence was greater in vocabulary and abstract reasoning than in rote memory and practical reasoning (Bradway and Thompson, 1962).

If intelligence tests had been widely used for a hundred years or more, we should undoubtedly have a great deal more information. But it is only recently that large numbers of individuals tested as children have become old enough to act as subjects for follow-up studies of mental ability in middle-aged or elderly people. Within the next several years many more follow-up studies and systematic longitudinal studies of intelligence will undoubtedly be conducted.

One interesting follow-up study has been made on middle-aged subjects. This involved the retesting, during 1949 and 1950, of 127 males to whom the Army Alpha Test had been administered in January 1919 as an

entrance test at Iowa State College. About half of those retested were still living in Iowa, and a number of these took the test on the occasion of a class reunion banquet; the rest were scattered throughout the United States and its territorial possessions and were tested by examiners living near them. Both subjects and examiners were paid for their time. Each subject was also asked to fill out a personal information sheet covering marital status, number of brothers and sisters, total education, area (urban or rural) in which he had grown up, yearly income, and other items which the investigator thought might show some correlation with the amount of change in the scores. Comparison of the 1919 test scores with those of students from twenty other colleges showed the Iowa State group to be a representative college sample.

On the 1950 retest, mean scores were higher for the total test and also for seven of the eight subtests. The only exception was the subtest dealing with arithmetic problems, where the mean scores decreased slightly. A number of the items in the personal data sheet, including the number of brothers and sisters, had no relation to the amount of increase in scores. Amount of education was a significant factor, however: subjects who had had over five years of college showed greater increases in their scores than did those who had had less than four years of college. Those who had moved from rural to urban areas, either at the time of entering college or later, showed greater increases in their ability to reassemble disarranged sentences than did those who had always lived in urban areas, probably indicating that the greater stimulation of the urban environment had some effect. Subjects with higher incomes made greater gains on the number series and analogies subtests, while those with the greatest number of hobbies and recreational activities made the greatest gains on the information subtest.

It is unlikely that the higher scores on the 1950 test were due to a practice effect, for, after extensive questioning, the twenty-six subjects who attended the reunion banquet were able to recall only one item from the original test, namely: "The number of a Korean's legs is: two-four-six-eight." Another thing that makes this study valuable is the high degree of motivation assured in both tests. In 1919 intelligence testing was relatively new, and the subjects were informed that grade-point average and future occupational status might be predicted from the results; hence they were undoubtedly highly motivated. On the retest, their pride was involved. They wanted to show that they "had not slipped." Nearly all of those tested wanted to know the test results (Owens, 1953).

Another study has shown that bright people continue to grow in intelligence up to at least fifty years, which was the age of the oldest subjects in the study (Bayley and Oden, 1955).

These longitudinal studies, then, would indicate that most aspects of intelligence do not decline through middle age. They thus tend to confirm the findings of the cross-sectional studies discussed previously. Both methods of study show that performance on verbal tasks and on tasks subject to lifelong learning is likely to improve with age.

CHAPTER SUMMARY

Every individual's development into a unique personality is determined by a very complex process of interaction between his *heredity* and his *environment* through *time*, each level of development depending partially on the levels previously reached. The process by which heredity continues to function after birth is called *maturation*. Environment influences development by supplying stimuli which elicit patterns of response already prepared by maturation and by presenting situations that require the learning of new responses or the changing of old ones. An *instinctive* behavior pattern, which is inborn, appears full-blown upon the first occasion that an adequate stimulus is presented, without previous opportunity for learning. Although such behavior is sometimes found in the lower animals, it is very rare in man. His behavior patterns fall on a continuum between pure instinct and pure learning, depending upon the degree to which learning has interacted with maturation in their development.

At the time of conception, the characteristics of both parents, and of many preceding generations, are passed on to the new individual through the union of the father's *sperm* cell and the mother's *ovum*. The *zygote*, or fertilized egg, from which the child develops receives exactly the same number of *chromosomes* (twenty-three) from each parent. The many

thousands of *genes* within the chromosomes are the real determiners of heredity, being responsible, alone or in combination, for every hereditary characteristic. The way in which the genes function is becoming better understood as the complex *DNA molecules* of which they are a part are being studied. When unlike genes are paired, the *dominant* one determines what characteristics will appear in the offspring; *recessive* genes take effect only when both in a pair are identical. Sex is determined by whether a female-producing *X-chromosome* or a male-producing *Y chromosome* from the father is joined with the X chromosome provided by the mother. No two individuals except *monozygotic* (identical) twins have the same heredity. Fraternal, or *dizygotic*, twins are no more closely related than ordinary siblings.

Under the guidance of heredity, the organism living in a normal environment undergoes a process of growth involving the nervous system, the muscles, and the endocrine glands. The child improves in ability to make adequate adjustments through two important changes in his nervous system: (1) an increase in the size of his brain and (2) an increase in the complexity of the neural patterns connecting receptors and effectors. *Structural* connections established by maturation may become *functional* through learning.

Although the infant has his total number of muscle cells at birth, they grow in size and strength through both maturation and exercise. The period of most rapid muscular growth is during adolescence.

The endocrine glands most closely involved in development are the *pituitary*, the *thyroids*, the *adrenals*, and the *gonads*. Improper functioning of the pituitary, which is the most important gland in influencing development, may lead to *dwarfism*, *giantism*, or *acromegaly*, the latter being an overgrowth of portions of the skeleton caused by oversecretion of the pituitary growth hormone in adult life. Thyroid deficiency results in cretinism, a peculiar type of dwarfism usually accompanied by subnormal intelligence. The adrenal glands produce *adrenal androgens* which regulate the development of adult sexual characteristics, particularly those associated with masculinity. Overactivity of the adrenal cortex produces *virilism*, excessive mas-

culinity. The gonads also produce secondary sex characteristics even before beginning to produce sperms or eggs at *puberty*. The gonads of the male produce *testicular androgens*; those of the female produce *estrogens*, which promote growth of the reproductive organs, and *progesterone*, which prepares the uterine tissues for supporting fetal life. *Menarche*, the stage when menstruation first appears, occurs between the ages of twelve and fourteen.

Although the rate and pattern of maturation differ significantly from child to child, the maturation process always follows an *orderly sequence*, proceeding along the *physiological gradient* from head to limbs. According to the *principle of motor primacy*, the neuromuscular structures must reach a certain stage of maturation before they can respond to stimulation. Maturation is characterized by a pattern of *individuation*—of development from whole to part, from general to specific.

The forty-week *prenatal period* includes a two-week *germinal* period followed by a six-week *embryonic* period, the remainder of the time being called the *fetal* period. During this time the organism receives nourishment through the *umbilical cord* from the mother's *placenta*. The fetus makes spontaneous movements and can also respond to external stimuli. There is some evidence that it can learn. It may develop abnormally as a result of such conditions as emotional disturbances in the mother, improper medication, excessive smoking by the mother, or radiation.

The newborn infant, or *neonate*, is differently proportioned from an adult. His senses of taste, smell, and touch, including sensitivity to temperature, are well developed as compared to those of hearing and vision. He makes general responses involving large portions of the body as well as specific, automatic responses known as *reflexes*. From birth he is a social creature, and his relationship with his mother

has a great deal to do with his later personality.

Restricted environment in infancy, such as that experienced in institutions, often causes serious handicaps in later social adjustment and may also affect intelligence. Sensory restriction in a normal environment, such as a temporary hearing defect at a crucial stage in development, may also have permanent bad effects. Lower animals reared in restricted environments suffer a loss in ability to learn and even to perceive painful stimulation normally. Studies have also shown that early social contact may be essential for the development of normal adult sexual patterns. Enriched environment, on the other hand, improves intelligence and heightens social adjustment.

At each period of life, *developmental tasks* are imposed on the individual by his society and by his own needs. Successful performance of these tasks, which vary from culture to culture, is made possible by past learning and by maturation.

Studies have shown that there is no one prime of life for all abilities. Two methods may be used to study the growth and decline of human abilities. In using the *cross-sectional method*, investigators need only one set of tests to study subjects of different ages, but it is difficult for them to obtain representative samples of subjects, to find tests that will be fair to all age groups, and to equate the factor of motivation for all groups. The *longitudinal method*, while making it possible to determine the initial abilities of all subjects, has the practical difficulty of requiring an elaborate research organization. Also, numerous forms of each test are needed in order to avoid the effects of practice. Studies made using both methods indicate that performance on tests containing visual and motor factors declines most rapidly with age, whereas performance on verbal and informational tasks may actually improve throughout the individual's productive years.

Chapter 4

Outline

THE MEASUREMENT OF PERSONALITY

PERSONALITY AS SOCIAL STIMULUS VALUE

PERSONALITY AS SELFHOOD

PERSONALITY AS A COMPLEX OF INTERACTING TRAITS

ROLE OF TYPES IN PERSONALITY AND PSYCHOLOGY

TYPES OF EXPLANATION

APPROACHES TO THE EXPLANATION OF PERSONALITY

PHRENOLOGY, PHRENOLOGICAL THEORY, AND PSYCHOLOGY

PHRENOLOGY

PHYSIOGNOMY

SOMATOTYPES

PHRENOLOGICAL DATA AND THE PSYCHOLOGICAL ORGANISM

GRAPHOLOGY

OTHER FORMS OF EXPRESSIVE BEHAVIOR

PERSONALITY THEORY MODELS

PSYCHOANALYTIC THEORIES

THE ANALYTIC THEORY OF JUNG

ADLER'S INDIVIDUAL PSYCHOLOGY

ORGANISMIC AND SELF-ACTUALIZATION THEORIES

STIMULUS-RESPONSE THEORIES OF PERSONALITY

CLINICAL METHODS OF STUDYING PERSONALITY

THE INTERVIEW

CLUES FROM PROJECTIVE DEVICES

Chapter 4 Clinical Approaches to Personality

The term *personality* has no standard meaning. There are some fifty different current definitions of it (English and English, 1958). Most of these definitions attempt in one way or another to include the whole person—all the abilities, tendencies, and other innate or acquired characteristics that are more or less consistent from one day to the next and distinguish him from other people.

THE MEANINGS OF PERSONALITY

When social scientists use the word *personality*, they are not thinking of a mysterious something that movie stars and politicians have more of than other people. They are probably using it to mean one of three things about a person: (1) his external appearance and behavior, or social stimulus value; (2) his awareness of self as a permanent organizing force in his life; or (3) his particular pattern or organization of measurable traits, both "inner" and "outer" ones. The second and third definitions generally imply that there is a consistency and stability of behavior patterns such that different individuals will respond to the same external situation in a manner determined more by personal characteristics than by the characteristics of the stimulus. Although none of the three aspects of personality can be strictly separated from the others, each lends itself to particular techniques of measurement and study. Approaches to the first two will be discussed in the present chapter; to the third, in Chapter 5.

No definite number of human traits has been established, but one early study listed 17,953

(Allport and Odbert, 1936). The length of this list suggests that some underlying characteristics may be included under more than one name. More recently, attempts have been made to study the consistent interrelations of traits in order to identify a smaller number of basic underlying factors. The study of personality is especially difficult because each personality is infinitely complex and contains apparently contradictory aspects. As one psychologist has expressed it,

"A personality is a full Congress of orators and pressure-groups, of children, demagogues, communists, isolationists, war-mongers, mugwumps, grafters, log-rollers, lobbyists, Caesars and Christs, Machiavellis and Judases, Tories and Promethean revolutionists." (Murray, 1940, p. 161)

Personality As Social Stimulus Value

An individual's *social stimulus value* is the effect he has upon others. It is determined by all those characteristics and qualities of the individual that act as stimuli for other people—physique, hair color, complexion, mannerisms, friendliness, helpfulness, and the like.

Some of the individual's social stimulus value derives from his role (function) in his social group and the expectations that both he and others in the group have for someone playing that role. Lawyers and policemen, teachers and students, play different roles in our society, and behavior approved for members of one group may be considered inappropriate for members of another. Some psychologists have attempted to explain personality differences as the result of the different roles people play in the various groups with which they are associated as though they were simply actors, with no characteristics of their own independent of their part in the play.

But though social stimulus value is an important concern of sociologists and psychologists, it obviously does not always reveal the true structure of personality. Just as the Greek actor's mask concealed the performer's identity, the individual's outer appearance and behavior may conceal a quite different psychological make-up. The swindler who uses charm to cheat his victims, the gruff person with "a heart of gold," the "sex kitten" who inwardly feels unloved and unloving—all these, and many others, are examples of persons whose outer appearance and behavior hide their inner nature. To gain a full understanding of a person, we must study his *inner personality structure*, as revealed by clinical methods, and his *traits*, as measured by the various types of objective methods.

Personality As Selfhood

Certain theorists emphasize that, from early childhood, the individual's concept of self is an important factor in guiding both his immediate behavior and the further development of his personality. He acts consistently in terms of the kind of person he believes he is—lovable or unattractive, bright or stupid, capable or clumsy. This self is his personality "viewed from within." Into it are integrated all his experiences with himself in his environment.

Very often an individual's public role causes changes in his private self concept. That is, behavior which was originally a consciously assumed role eventually becomes a part of the self concept. Thus in military training an over-protected "mama's boy" may come to see him-

self as, and to be, a self-reliant, proud, and effective person—a "real Marine."

In addition to the conscious self, a person's intrapersonal organization includes elements of which even he may not be directly aware. These deeper, unconscious levels of personality may be studied by means of *hypnosis* (see Chapter 14) or *projective techniques*, which will be discussed in this chapter.

Personality As a Complex of Interacting Traits

Another approach to personality is to study the *measurable traits* of the individual. Traits are defined as characteristics—such as mental ability, mechanical aptitude or talent, masculinity, introversion, sociability—that can be observed and tested objectively or inferred from observable, measurable behavior. These are often called *dimensions* of personality because they can be measured on a quantitative continuum.

One of the most persistent errors in popular thinking is the notion that people are either introvert or extravert, musical or not musical, smart or "dumb," and so forth. Like most other popular "either-or" judgments, such concepts are inaccurate. Just as everyone has some amount of height and weight, so everyone has some degree of intelligence, musical aptitude, introversion-extraversion, creativity, and so on. Thus the basic problem in describing a given individual is not deciding which traits he does or does not possess, but finding *how much* of each trait he possesses and how the traits *interact* in the total pattern of his personality.

THE ROLE OF THEORY IN UNDERSTANDING PERSONALITY

Psychologists have developed many theories in their attempt to explain human personality. *Explanation*, however, can have a number of meanings, depending on the nature of the thing being explained and the question being

asked about it. Before taking up the various theories of personality, we shall look at the different types of explanation that can be sought by investigators working in different settings and with different purposes.

Types of Explanation

There are at least four different types of explanation. These have been described as (1) deductive, (2) probabilistic, (3) functional or teleological, and (4) genetic (Nagel, 1961).

The *deductive* type of explanation is found most often in the physical sciences, such as physics and chemistry. In this type of explanation, the event to be explained—such as ice floating on water, moisture forming on the outside of a glass filled with ice water, or the freezing point of water being lowered by the addition of salt—is deduced by the rules of logical inference from a set of laws and premises. This kind of explanation is possible when all the necessary and sufficient conditions are known.

The *probabilistic* type of explanation is used when the premises are not sufficient to make deduction possible. Nevertheless, the available information may strongly suggest a particular situation or generalization as the cause of the event under consideration. Historians frequently make use of this type of explanation. Plutarch, for example, tells us that it was because Cassius hated tyranny that he joined in the plot to assassinate Caesar. This cannot be specifically deduced from the information available to us, but it follows from the general observation that tyrant-hating upper-class Romans were *more likely than not* to plot against potential tyrants. Since Cassius was such an individual, we can say that this is the *probable* explanation of his participation in the plot.

The *functional* or *teleological* type of explanation is one in which the event is explained in terms of the role it plays in maintaining or realizing certain goals or purposes of a system. Often this kind of explanation is used in the biological and social sciences. Respiration or circulation or the clotting of blood after injury can be explained in terms of the functions these processes serve in the body in maintaining life and health. In clinical work, defense mechanisms are explained in terms of the adaptive and adaptive roles they play in helping the individual to feel adequate.

The *genetic* type of explanation is frequently found in the social sciences and often in the other branches of science. The term *genetic* here means "genesis" or "beginning" and has

nothing to do with the mechanisms of heredity. In a genetic explanation, an event is explained in terms of the events which led up to it. One might explain the existence of the American Constitution, the office of the United States President, the Grand Canyon, or the rise to social eminence of some person in a genetic fashion.

All four of these methods are used in scientific explanations. The deductive type of explanation is frequently regarded as the ideal type, but it is neither necessary nor possible in every branch of science. Those branches of science that do use the deductive model often use one or more of the other types as well. Both the purpose of the investigator and the knowledge and tools already available help to determine the kind of explanation he will seek; this, in turn, imposes restrictions on the kinds of data he will collect and the way he will use his data in formulating an explanation.

Approaches to the Explanation of Personality

Two general approaches have been taken by psychologists in their attempts to understand personality. These approaches have been labeled (1) *idiographic* and (2) *nomothetic*. Proponents of the idiographic approach are especially concerned with the aspects of an individual's personality that are unique to him. They would subscribe to the view that in certain respects every man is:

- a. Like all other men.
- b. Like some other men.
- c. Like no other men.

Thus the idiographic theorists do not exclude from consideration the characteristics that people share with others of their particular group or with all human beings. But their special concern is a description of the way these traits interact to make an individual unique.

The nomothetic approach to personality attempts to describe with precision those psychological elements which are presumed to be common to all individuals. This approach is analogous to efforts in the physical sciences where the emphasis is placed on the discovery of elements and general laws that can be ap-

plied to explain or predict *all* cases. Once the basic elements—in the field of personality theory referred to as *common traits*—are identified and can be measured, it should be possible, nomothetic theorists feel, to describe the personality of an individual completely in terms of his particular pattern of traits. They believe that someday behavior will be predictable if stimuli, background elements, organic conditions, and traits are adequately identified.

The major difference between the idiographic and nomothetic approaches lies in the way in which the “uniqueness of the individual” is defined. For the idiographic theorists, it consists of genetic, acquired, and environmentally modified dispositions or traits or systems of behavior which are different from those of any other person. They believe that the elements of personality cannot be meaningfully analyzed out because they already have become fused in the very process of personality formation.

For the nomothetic theorists, the uniqueness of an individual is defined by his particular patterning of the elements which are present in each person in some degree and combination. The nomothetic theorists are inclined to talk about tests rather than individuals as being in some respects:

- a. Like all other tests.
- b. Like some other tests.
- c. Like no other tests.

In more technical language, test scores are statistical variables. A variable may be described as being related to *all* other variables (hence reflecting a general factor), to *some* other vari-

ables (reflecting a group factor), or to *no* other variables (reflecting a unique factor).

These two different theoretical approaches to the understanding of personality suggest different types of explanation. The idiographic theorist would be inclined toward a functional or teleological explanation of an individual's behavior. He would measure common traits too, but he would give a central role to the individual's idiosyncratic characteristics. It is likely that he would be concerned with the developmental history of the individual and would use a genetic explanation in regard to certain components of the individual's behavior. Instead of deductive predictions based on statements that are universally true of people, he would make specific predictions about this individual's behavior on the basis of statements which were generally true of the particular individual.

The nomothetic theorist would be more inclined toward a deductive model in which statements true about people in general would be used. Where an exact prediction was not possible, a probabilistic one might be used: the chances of an individual's showing certain behavior or being successful in a particular activity or the percentage of a group that might be expected to show certain reactions. An individual's behavior would be explained on the basis of universal traits, situational and background factors, and organic factors. In assessing an individual's personality, the nomothetic theorist would use tests standardized on the general population. He would describe an individual by comparing him to the “average person.”

BODY-TYPE THEORIES OF PERSONALITY

A premature attempt at a deductive type of explanation in personality study is seen in the various body-type theories. If you know certain things about an individual's physique, so the theories go, you can make many predictions about his personality. Many popular beliefs—

that persons with high foreheads behave in an intelligent manner, that redheads have outbursts of fiery temper, that fat men are jolly—have grown out of the assumption that personality can be explained in terms of physical anatomy, or *morphology*. Many morphological sys-

and-shoulders photos of all candidates, divided into small groups. They were asked to rank the photos in each group as to which man would be the best leader, the next best, and so on. As might be expected, there was a relatively high degree of agreement among the subjects as to which men looked most like leaders. However, their judgments showed only a very low correlation with the actual leadership ratings of the candidates that had been made earlier by the skilled judges (Mason, 1957).

Another study found judgments of intelligence based on physiognomy to be invalid when compared with the results of intelligence tests. In this case the men themselves (317 airmen), rather than their photographs, were observed briefly by subjects who attempted to judge their level of intelligence on the basis of their appearance (Ray, 1958).




At the present time, any value that physiognomy has in measuring the social stimulus value of a person can probably be explained away on the basis of popular stereotypes or "pictures in the mind." If most people think that a square jaw is a sign of leadership, they will tend to follow the man with a square jaw and thus make him a leader and he will think of himself as one.

Somatotypes

Characteristics of the body as a whole, rather than just the face or the head, have also been studied in relation to personality. A body-type theory which has been investigated extensively in relation to mental illness was proposed by a German psychiatrist (Kretschmer, 1925). He noticed that schizophrenic patients as a group seemed to differ markedly in physique from manic-depressive patients. On the basis of his observations, Kretschmer suggested that there were two main types of body structure—the tall and thin and the short and plump—each associated with a characteristic temperament pattern. He went on to set forth the possibility of predicting on this basis the type of disorder a given individual would develop if he were to become mentally ill. Although clinical experience upholds Kretschmer's observations to a slight extent, studies in the main fail to support the relationships he suggested.

An outgrowth of Kretschmer's work which has become much more widely known is Sheldon's *somatotype* theory (Sheldon, 1942). According to Sheldon's classification, there are three basic body types (somatotypes), each of which can be identified with a corresponding personality type. ◊

SHeldon's CLASSIFICATION OF BODY TYPES

	BODY TYPE	PERSONALITY TYPE	TYPICAL TRAITS
	Endomorphy (tendency toward roundness and softness)	Viscerotonia	Fond of food, inclined to eat too much, apprehensive, insecure, amiable, sleeps well, conforms to social conventions
	Mesomorphy (predominance of muscle and bone)	Somatotonia	Adventurous, likes strenuous exercise and cold showers, dresses informally, withstands pain easily and willingly
	Ectomorphy (fragility and linearity in body build)	Cerebrotonia	Asocial, unamiable, lacks desire for exercise, nonadventurous, does not withstand pain easily

Based on Sheldon, Stevens, and Tucker, 1940, and Childs, 1950

Sheldon's major study was performed over a five-year period on two hundred young men, all college students or college graduates engaged for the most part in academic or professional careers. These men were rated as to somatotype and were also interviewed to determine temperament traits. High correlations were reported between morphology ratings and temperament. Unfortunately, study of Sheldon's table of correlations by statistical experts has revealed serious computational errors and shown that some

of the correlations are mathematically impossible (Lubin, 1950).

Controversy arising from Sheldon's claims has stimulated research on the part of other psychologists to determine whether his theory can stand the test of impartial investigation. In one recent study of 10,000 male freshmen the relationships between body type and temperament described by Sheldon were either absent or so small as to have no practical significance (Hood, 1963).

EXPRESSIVE BEHAVIOR AS A CLUE TO PERSONALITY

Other popular attempts to understand personality are based on the individual's expressive behavior rather than his anatomy. Among the most common forms of expression so used are handwriting, voice, and posture.

Graphology

Assessment of personality characteristics by studying a person's handwriting is known as *graphology*. Although many psychologists feel that it has no more value than palmistry or the reading of tea leaves, it has been studied scientifically in recent years by rigorously controlled methods. The general conclusion is that graphology may eventually prove to have some value in predicting personality traits.

There is good evidence that experienced graphologists agree with each other in analyzing handwriting, but this does not necessarily mean that their analysis is correct. For example, in a recent study, the letters *i* and *j* were regarded as showing attentiveness to detail if the dot was placed close to and directly above the stem of the letter. Graphologists showed close agreement in their count of *i*'s and *j*'s of this type and also of strokes agreed on as illustrating other personality traits. ▲ (Galbraith and Wilson, 1964). However, this does not show that the manner of dotting *i*'s really indicates attentive-

ness to detail. In order to do this, one would have to conduct a more extensive study, comparing an individual's scores on other measures of attentiveness to detail with his *i*-dotting habits.

▲ ANALYSIS OF HANDWRITING

TRAIT AND EXPLANATION	ILLUSTRATIVE STROKES
Attentiveness to detail Dot close to and directly above stem of letter	<i>i j</i>
Domineeringness Lines like cross on "t" and dot on "i" slant downward and are pointed at ends	<i>D i</i>
Persistence Strokes made in form of loop or knot	<i>f f f</i>
Self-consciousness Succession of curved or pointed strokes increasing in height	<i>m u</i>
Stubbornness Straight, rigid, braced strokes, forming points rather than curves	<i>d m</i>

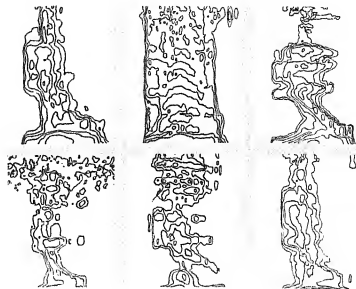
Two studies suggest that the use of unnecessary beginning strokes may be related to certain personality characteristics. Secondary beginning strokes, made on the letters *u*, *v*, *w*, and *y*, and indicated by the dotted line, *-w-*, represent a retention of writing habits learned in the first years of school. Primary beginning strokes, on the other hand, are voluntary elaborations or embellishments of the basic letter and may take various forms. Both primary and secondary stroke users showed highly authoritarian attitudes. Users of secondary beginning strokes were found to have lower scholastic aptitude than those who did not use such strokes. They also tended to be passive and to have difficulty in adjusting to new situations and in controlling their impulses. Users of primary beginning strokes were actively self-assertive but showed greater social conformity than either users of secondary strokes or those who used neither kind of beginning stroke (Linton, Epstein, and Hartford, 1961, 1962).

The most comprehensive attempt to measure individual signs is the Lewinsohn-Zubin Scales (Lewinsohn and Zubin, 1942). These scales include twenty-two variables and also give a complex overall score, which locates the handwriting sample on a contraction-release continuum. Scores in the middle range indicate rhythmic balance or normality, while those near either extreme indicate psychological disturbance. One study comparing the Lewinsohn-Zubin Scale scores of thirty-three delinquents and thirty-three nondelinquents found that the nondelinquents tended to show more normality, with the delinquents nearer the extremes (Wolfson, 1949).

Some graphological studies have been concerned with *global* or total impressions of handwriting rather than individual signs or letters (Fluckiger, Tripp, and Weinberg, 1961). Such judgments, however, are highly subjective.

The sex of the writer is one thing that can be determined quite well from handwriting. Usually even untrained judges can tell about two thirds of the time whether a given sample of writing was done by a man or a woman. Since sheer guessing would make one's judgments correct half of the time, this is not a strong relationship. Pressure appears to be the most important cue (Goodenough, 1945).

These six voiceprints were made by five different people saying the word "you." Can you tell which two were made by the same speaker?



A number of objective techniques have been developed for measuring specific characteristics of handwriting, such as pressure and speed. Both the pressure exerted on the point of the pen and the pressure exerted in gripping it can be measured by means of a sensitive table with a recording device. Studies using such devices have confirmed that men use more pressure in gripping the pen or pencil than do women. Usually the pressure-measuring device also measures speed, but there is a device to measure speed alone (Katz, 1948).

Unfortunately, very little has actually been done with these measuring devices in experimental graphology, though one early investigator did find a positive correlation between point pressure and the personality variables of "energy" and "expressiveness." He also showed that an adult's handwriting remains about the same with regard to pressure and speed (Pascal, 1943).

In general, graphology has thus far proven to be of little, if any, practical value in assessing personality traits (Fluckiger, Tripp, and Weinberg, 1961). It is possible, however, that further research may substantiate some of the claims that have been made. Should graphology prove to be as valid as its advocates claim, it would have a great practical value because of the ease with which samples of handwriting can be obtained, even when subjects are noncooperative.

It is interesting to speculate on the impact of graphology on human relations should it prove to be a valid predictor of behavior and should knowledge of its validity become widespread. Obviously, a person's social stimulus value would be greatly affected, since it is very difficult to disguise one's handwriting.

Other Forms of Expressive Behavior

Relatively little research appears to have been done on the relationship between personality traits and such forms of expressive behavior as voice and posture.

One study compared the vocal characteristics of 372 college students with their scores on certain personality variables as measured by a self-inventory (p. 151). Those who scored high in dominance tended to have louder, more resonant, and lower-pitched voices than those who showed submissiveness on the self-inventory (Mallory and Miller, 1958).

Research of the sort described above may be greatly facilitated by the use of "voice prints" such as those shown here. ■ Since every individual's voice print for a given word is unique and unchanging, this recently developed technique has proved to be of use in the identification of criminals. It should also be of value in other areas where an objective measure of vocal characteristics is needed. The relationship between voice patterns and other personality traits is a matter that has yet to be determined by careful research.

Posture undoubtedly plays a part in many "snap judgments" of personality. That is, the stereotyped idea of the leader usually includes an upright, almost military bearing, whereas the scholar is thought of as being stoop-shouldered. It has been found that people with poor posture often have inferiority feelings (Faterson, 1931). However, this fact alone does not tell us whether the poor posture has been caused by the inferiority feelings or vice versa.

PERSONALITY THEORY TODAY

Experimental psychologists, by and large, have focused their attention on trying to find relationships between stimulus conditions and behavior, making as few assumptions as possible about intervening processes in the organism. They have felt that a full theory of personality is both unnecessary and premature at this stage in our knowledge. Clinicians, however, who have been forced to work out a rationale for dealing with troubled patients, have developed several theories. Most of these have been either *functional* or *genetic* or both, and most have been inferences from observation in clinical situations, with little or no attempt at experimental control or statistical analysis. In several cases later workers have attempted, with some success, to test the theories experimentally, and modern clinicians are far more sophisticated statistically than their predecessors. Some of

the better known clinically oriented theories and a few experimentally based ones will be summarized briefly in this section.

Psychoanalytic Theories

When *psychoanalysis* is mentioned, most people picture a patient lying on a couch pouring out his life story to a therapist in the course of a long series of sessions running from five to fifty dollars for each "fifty-minute hour." True enough, psychoanalysis is a major method of therapy for the emotionally disturbed. However, it is also a major theory of personality structure that is applied to both normal and abnormal individuals. In fact, although few modern psychologists and psychiatrists subscribe wholeheartedly to orthodox psychoanalytic theory, its concepts have profoundly influenced the devel-

opment of other personality theories, as well as techniques of therapy.

Classic psychoanalysis. Psychoanalysis was originated by Sigmund Freud, a Viennese neurologist who, in treating emotionally disturbed patients, was impressed by the frequency with which sexual problems seemed to be at the source of the trouble. He came to believe that the fundamental source of energy underlying all human behavior stems from an instinctive drive—called the *libido*—which is sexual in nature. It is important to note that Freud used the term *sexual* in a very broad sense to refer to any type of physically pleasurable activity. Thus the *libido* would include all instinctive urges associated with bodily satisfactions.

Freudian theory divides the personality structure into three parts—the id, the ego, and the superego. ♦ In the terminology of modern psychology, these are logical constructs. Though they are less well defined than such constructs as “hunger,” “motivation,” or “drive”—and therefore must be used cautiously—they nevertheless have provided a convenient and systematic framework for studying certain

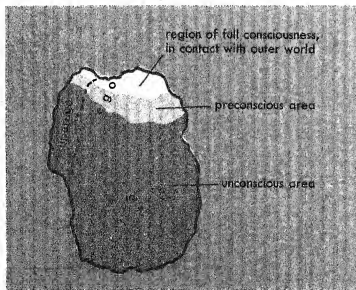
psychological processes, especially in clinical work.

The *id* is conceived as the primitive, unconscious part of the personality, the storehouse of the *libido*. Composed of instinctive organic cravings, the *id* is characterized by many unrestrained pleasure-seeking impulses which are constantly demanding expression. The *id* is thus basically irrational and selfish.

The *ego*, according to Freudian theory, is the rational aspect of the personality which regulates the activities of the *id* and guides the organism's behavior to meet the demands of reality. The *ego* is concerned with maintaining social approval and self-esteem and controls expression of the *id*'s impulses according to their acceptability in the real world.

The individual's moral attitudes reside in the *superego*, which corresponds roughly to the “conscience” and guards the uncompromising ideas of right and wrong which the individual has learned as a child. The demands of the *superego* are in continual conflict with those of the *id*, and both seek expression through the *ego*. Caught in this conflict, the *ego* usually resorts to some form of compromise which will at least partially satisfy both *libido* and conscience. Inability of the *ego* to make such a compromise leads to the appearance of neurotic symptoms, which Freud regarded as symbolic outlets for the frustrated impulses of the pleasure-seeking *id*. Freud thus saw an inherent conflict between the requirements of society, with its rules for restraint, and the instinctive strivings of the individual and believed that neuroses stemmed from this conflict.

Psychoanalytic theory also deals with personality development. The personality develops as different parts of the body successively become the focus of libidinal urges and bodily satisfactions. First is the *oral* period, during which satisfactions center around sucking, putting things in the mouth, and later biting and chewing. It is important that the child have adequate satisfaction of these needs if he is to develop normally. Next is the *anal* period, during which bowel control is achieved and during which the focus of pleasure is the eliminative processes. Trouble sometimes ensues if the child is taught to regard such processes with revulsion or finds that his acceptability to his parents depends on



♦ Freud envisioned the personality as made up of layers, of which only the top one, a tiny segment of the whole, was fully conscious. By far the greatest part, he thought, consisted of unconscious, irrational, pleasure-seeking tendencies.

his ability to meet their requirements for cleanliness, or if he finds that he can exercise power over his parents by producing his feces at undesired times and withholding them at other times.

In the *phallic-Oedipal* stage, roughly between the third and the fifth year, signs of sexuality appear in the form of genital manipulation and exploration, and there is a strong attraction for the parent of the opposite sex, with jealousy toward the same-sexed parent. Successful resolution of this conflict occurs when the boy learns to identify with his father and the girl with her mother. A *latency* period follows, during the early school years, until at adolescence the *genital* period begins. In this period the individual ultimately becomes emotionally emancipated from his parents and achieves adult sexuality.

With severe deprivation or traumatic early experiences, development may be fixated at one of the early stages. Thus the miser or the person unduly concerned with meticulous tidiness is regarded as an *anal personality* because the traits of stinginess and obsessive orderliness are presumed to be related to unsatisfied cravings during the period of preoccupation with elimination.

Thus psychoanalytic theorists consider that the individual's ability to adjust in later life is determined largely by his early childhood experiences. If painful conflicts have been repressed in childhood without being adequately resolved, they will continue—though unconscious—to influence the individual's thoughts, feelings, and behavior, causing emotional tension and inability to adjust. Psychoanalytic therapy for such neuroses will be discussed in Chapter 14.

Freud continued to refine and defend his system until his death in 1939. Because psychoanalysis has been widely used and is more time-consuming and expensive for the patient than other forms of psychotherapy, it has been more extensively discussed—and, in some quarters, more violently criticized—than have the others. Even Freud's severest critics, however, acknowledge certain of his contributions to modern clinical psychology and psychiatry:

1. In applying the concept of determinism to the study of behavior (as opposed to the rationalists' claim that man has full control over his behavior), Freud for the first time emphasized

the importance of unconscious processes in the motivation of human behavior.

2. Although most modern psychologists believe that Freud overemphasized the role of sexual factors, psychoanalysis "opened up" the scientific study of sexuality and indicated its importance as a source of adjustment problems.

3. Psychoanalysis focused attention on the importance of childhood experiences in later personality development and adjustment.

In view of these significant contributions, Freud is generally considered the most influential figure in the rise of modern psychotherapy. Nevertheless, certain difficulties with his system have led some therapists to adopt a radical modification of orthodox psychoanalysis and others to reject the method entirely. Although psychoanalytic principles have permeated all psychotherapy, *orthodox* Freudian analysis is not in common usage today.

Neo-Freudian theories. Many followers of Freud could not agree with his assumption that man's emotional problems are products of an inevitable internal conflict between his instincts and the censoring action of the ego and superego. These later psychoanalysts have emphasized the variable role of the environment and social interaction in personality development; in varying degrees they emphasize the individual's present situation as well as his past experiences. The theories of Karen Horney, Erich Fromm, and Erik Erikson typify somewhat different aspects of this newer approach.

Karen Horney was an American psychoanalyst who accepted Freud's concepts of strict causality and of unconscious emotional factors in motivation but rejected his theory of universal, fixed stages of development, determined by heredity. Instead she saw a child's development as determined by his experiences and his interpretation of them. According to her theory, difficulties arise not from conflicts between ego, id, and superego but from conflicts between a person and his environment. Thus conflicts are common but not inevitable. With a warm and loving home they may be resolved or avoided, and the individual may become a constructive, mature human being. This does not mean, however, that the child should be protected from all conflict and frustration or permitted to

escape the developmental tasks outlined in Chapter 3. Such an upbringing would result in his becoming a weak, dependent adult.

On the other hand, if the child is constantly made to feel insecure and unloved, he may develop a *basic anxiety*, from which he will try to protect himself by various defenses. Such a person may move toward others and become over-compliant, against them in hostile aggressiveness, or away from them in withdrawal and isolation. A competitive society such as ours is especially conducive to such insecurity and self-defeating defenses.

Horney led the revolt against Freud to such an extent that it is doubtful whether she can fairly be classed as a Freudian. She insisted, however, that she was modifying an old system, not creating a new one (Horney, 1945).

Erich Fromm points out that whereas an animal achieves an instinctive harmony with nature, human beings have the problem of finding out what kind of creatures they are and creating the kind of social environment that will fulfill their needs. Fromm recognizes five basic needs which have become embedded in human nature: during the course of evolution but which can be explicitly expressed and satisfied only as opportunity is offered by the social environment. These are the need for *relatedness*, the need for *rootedness*, the need for *identity*, the need for *transcendence*, and the need for a *frame of orientation*.

The first three of these needs have been intensified through the course of history as man has become further separated from nature and especially as he has gained greater freedom. Too often the greater freedom has led to a feeling of loneliness and isolation not experienced by the serf of medieval times, for example, whose role in society was clearly defined and who had little responsibility for his own welfare. Some people are tempted to give up their freedom and try to find identity and relatedness through conformity. Fromm argues that a better solution is to join with others in shared effort to improve the social order. In doing this, the individual may also satisfy his need for transcendence, or control over his animal nature.

To meet all five needs, it is essential for him to adopt a productive orientation toward life rather than one of the many nonproductive ori-

entations that are possible. As an outstanding nonproductive orientation of the twentieth century, Fromm points to the *marketing* orientation—the tendency to see oneself not as an active, thinking, loving person but essentially as a commodity to be sold or invested in the marketplace. The productive orientation is expressed in creative thought, in work of an artistic or craftsmanlike nature, and primarily in love, a “mystical experience of union” with others (Fromm, 1955, p. 32).

Erik Erikson's best-known modification of psychoanalysis is his substitution of eight psychosocial stages for Freud's five psychosexual ones. Erikson sees each stage in man's cycle as characterized by a particular conflict which comes into focus at that time and must be resolved in a positive direction if future development is to proceed normally. Thus each stage may be thought of as a crisis in development.

The eight crises in man's life cycle, as listed by Erikson (1960), are summarized in the chart. ■ These stages are not separate events following each other like beads on a string, nor are the conflicts ever completely and finally resolved. Successfully meeting one crisis builds strength for the next one, but every individual retains some of the negative aspects of early crises as a residue of immaturity carried throughout life. Nurses, for example, have noted that persons who have undergone serious operations tend to relive these early crises in the course of their recovery, especially by becoming, for a time, suspicious (untrusting) or over-dependent. Of course the physically healthy are still sometimes troubled by feelings of guilt or inferiority. They can overcome such feelings much more easily if the original crisis involving these feelings was successfully resolved.

It is crucially important for a high proportion of adults in a culture to achieve a considerable degree of integrity if new generations are to be guided in their turn toward integrity and effectiveness as human beings. Fortunately, it is often possible to overcome early handicaps and even late in life to achieve the feelings of identity, intimacy, and integrity characteristic of effective adulthood.

Although based upon clinical observations, Erikson's theory appears to stand up under objective testing.

EIGHT CRISES IN THE LIFE CYCLE

Stage	Crisis	Aids for Successful Resolution	Obstacles to Successful Resolution
Infancy	Trust vs. mistrust	Physical and psychological needs adequately met.	Absence, unpredictability, or inconsistency of care.
Early childhood	Autonomy vs. doubt, shame	Consistent discipline with opportunity for reasonable degree of choice in initiating and structuring activities.	Disapproval and discouragement of child's initiative; inconsistent or too severe discipline.
Play age	Initiative vs. guilt	Encouragement of child's interests and early tries; evidence of adult confidence in him.	Discouragement and adult focus on child's failures and shortcomings.
School age	Industry vs. inferiority	Encouragement and guidance in learning basic intellectual and social skills.	Too much or too little demanded by adults.
Adolescence	Identity vs. self-diffusion or negative identity	Earlier and current help in seeing useful role and formulating life goals; admired models; a healthy self esteem.	Lack of clear role to play; recurrence of earlier crises; inner turmoil from physical changes and new social demands.
Young adulthood	Intimacy vs. isolation	Successful resolution of identity-diffusion crises.	Overemphasis on individualism, undervaluing of intimacy in our society.
Adulthood	Generativity vs. self-absorption	Creative life work; concern for autonomy and growth of others.	Failure to develop concern for others' well-being; self-centeredness.
Later life	Integrity and self-acceptance vs. despair	Self-confidence; appreciation of other cultures and earlier generations and sense of continuity with them.	Sense of failure and futility.

Adapted from Erikson, 1960

An Ego Identity Scale was devised, having seventy-two items designed to reveal success or failure in resolution of the first six stages of psychosocial development, as defined by Erikson. The scale was administered to two groups of Navy recruits, one composed of persons who had made a good psychosocial adjustment and the other made up of individuals whose adjustment was marginal. Adjustment was determined by answers to an adjective checklist which measured self-esteem and by ratings of fellow recruits. The well-adjusted group made significantly higher scores on the Ego Identity Scale (Rasmussen, 1964).

Several other quite distinct theories have developed based in part on Freudian formulations.¹ In several cases their proponents regard themselves as still basically Freudian in orientation. Others, like the theories of Carl Jung and Alfred Adler, represent a definite break from the Freudian school of psychoanalysis.

1. A theory of ego development formulated by Jane Loevinger is presented in her article in Reference Manual Section B.

The Analytic Theory of Jung

Carl Jung was for a number of years an admirer and friend of Freud. However, they came to disagree strongly on the importance of sexuality in the personality and finally broke off their association entirely. In his own theory, known as *analytical psychology*, Jung emphasized the teleological (purposive) aspect of personality in a way that Freud had never done. For Jung the future, as exemplified in the goals and aspirations of the individual, is fully as important as the past in determining personality structure and present behavior. Whereas Freud saw the same old instincts being satisfied in various ways throughout life, Jung believed that man is able to progress to more complete, more highly differentiated levels of development. The most difficult task, and the goal which most people seek but few reach, is an integration of the conscious and unconscious parts of the personality in a mature, stable, and unified

self. Such a self has both the courage to resist group pressures and the ability to acknowledge and cope constructively with its primitive inner nature. Maladjustment and mental disorder, Jung felt, resulted from either a slavish dependence on conformity or an over-reliance on conscious reason, with a denial of the unconscious parts of one's nature.

Jung did not, however, consider knowledge of the goals of the personality to be enough. An understanding of the past is also essential. It is here that the unconscious plays a vital role. But Jung emphasized a racial, or *collective*, unconscious as well as an individual one. Every individual, he maintained, is the repository of the experience of his race and is endowed with a storehouse of "racial memories," called *archetypes*. Hence, Jung traces the origins of personality back much further than infancy, to the early experiences of the human race itself and even beyond. The idea of such racial memories has been rejected by most modern psychologists.

Jung is responsible for the concepts of *introversion*, or orientation toward the subjective, inner world of thought and feeling, and *extraversion*, or orientation toward the external world of things and people. The validity of this concept has been established by objective methods, as we shall see in the following chapter, and it has proved of considerable value in the study of personality.

Adler's Individual Psychology

Like Jung, Alfred Adler emphasized the future dimension of personality, stressing the importance of goals (teleology). However, he emphasized man's social nature to a much greater extent than either Freud or Jung had done. He placed social needs on a par with Freud's instincts and Jung's archetypes as primary sources of motivation and personality development. Adler believed that there is one final goal which men seek and which gives unity to their personalities. At an early stage in his studies Adler called this fundamental striving the *will to power*, and conceived of man as driven by an innate lust for domination over others in order to compensate for deep-rooted but concealed

feelings of his own inferiority. It was his thinking that gave us the term *inferiority complex*, which is still widely used.

Later, however, as he realized more fully the importance of man's social context, Adler adopted the term *striving for superiority* as more accurately expressing the nature of man's most basic motivation. By superiority he meant a higher level of development or a better integrated personality. All man's various drives are not really separate urges, according to Adler, but manifestations of the striving for superiority. While the neurotic person may seek power and self-aggrandizement, the normal person's strivings are social in nature and take into account the needs of others. By extending his desire for superiority to society as a whole and working for a superior social order, the individual compensates most effectively for his own weakness. Like the striving for superiority, the social interest is inborn, although it must be developed by proper education and training.

Every person develops his own way of striving for the basic goal of superiority—his own *life style*. In some individuals—the daredevil, the bookworm, the good-time Charlie—the style is more obvious than in others, but each style is unique. This concept of personality as something unique to the individual has been accepted by many modern psychologists. It is, as we have seen, an *idiographic* principle.

Organismic and Self-Actualization Theories

In the development of their theories, some psychologists have been strongly influenced by *field theory*, a concept which emerged from analogy with the physical sciences. Based on the study of electromagnetic fields, this theory postulates fields of force which are in dynamic and constantly shifting equilibrium. Psychological events, like physical events, are thought to represent a balance and interaction of many forces, and a change anywhere in the system is seen as affecting the whole system. For psychologists applying this theory, behavior is shaped not by individual chains of cause and effect, but by the combination of forces which make up the entire field. The influence of field theory first became evident in psychology with the ap-

pearance of Gestalt psychology (see page 7), with its emphasis on patterns in experience and behavior.

Goldstein's organismic theory. A personality theory which has borrowed heavily from both field theory and Gestalt psychology is *organismic theory*, a leading exponent of which is Kurt Goldstein. As a neuropsychiatrist working with brain-injured soldiers in World War I, Goldstein arrived at the principle that particular symptoms could not be understood merely as the product of particular diseases or injuries but only as products of the organism behaving as a whole. The organism is a unity, and what happens in any part of it affects the whole. Organization is natural to the organism, and disorganization means disease. Although constituent parts have to be differentiated for study, they do not operate in isolation.

Organismic theory stresses primarily the orderly unfolding of the 'inherited potentialities of the organism. However, it does recognize that an appropriate environment is essential if this unfolding is to occur. As one might expect, the organism is thought to be motivated by one main drive rather than by a number of different, independent drives. This drive is man's constant striving to realize his inherent potentials and is called by Goldstein *self-actualization*.

The proponents of organismic theory are idiosyncratic in their approach, feeling that intensive study of one individual can yield more knowledge of the important relationships in personality and motivation than can study of some particular trait or function in a large number of individuals. Therefore, the theory has appealed particularly to clinical psychologists, who must work intensively with single individuals.

Rogers' theory of the self. Among the best known of the organismic theorists who have achieved recognition also as therapists is Carl Rogers. Rogers emphasizes the private world of the individual, the world of experience, which he calls the *phenomenal field*. It is the individual's perceptions and interpretations that determine his behavior. Thus to understand his behavior, it is not enough to know the external situation: one must understand how things look to him.

A differentiated portion of this field is his *self concept*, which develops out of his interaction with his environment and becomes his most valued possession. The individual behaves in ways that are consistent with his picture of himself and tends to reject or distort incoming information that is threatening to the self. Thus experience may be *symbolized*, in which case it becomes clearly perceived and fully conscious, or it may be denied symbolization and remain below the level of consciousness, or it may be ignored.

The most basic drive of the human organism is toward self-actualization. In the words of Rogers, "The organism has one basic tendency and striving—to actualize, maintain, and enhance the experiencing organism." (Rogers, 1951, p. 487) Mental illness comes when one does not dare to be oneself or to acknowledge one's real experiencing. Once the alternatives are clearly perceived and adequately symbolized, the individual always chooses the path of growth. Thus in therapy it is the patient's own inner urge toward growth and wholeness that makes recovery possible, and the therapist's task is merely to provide the safe and encouraging climate in which the patient can explore his own feelings and face and resolve his problems himself. This type of therapy is discussed in Chapter 14. Rogers has gone further than most clinicians in developing quantitative methods for comparing the variables operating in successful and unsuccessful cases of therapy.

Maslow's self-actualization theory. Another leading proponent of self-actualization is Abraham Maslow. Feeling that psychology has restricted itself almost entirely to the study of the abnormal and has concentrated upon man's weaknesses, neglecting his strengths, Maslow has sought to round out the picture by studying emotionally healthy individuals. He regards man's inborn nature as basically good, but sees the innate tendency toward growth and self-actualization as rather weak and fragile, easily overcome by social pressures and the like.

Maslow arranges man's inborn needs in a hierarchy of priority. When those of greatest potency—the physiological needs such as hunger and thirst—are satisfied, the needs on the next step of the hierarchy—safety needs—press

for satisfaction. After these come, in order, needs for belongingness and love, needs for esteem, needs for self-actualization, needs for knowledge, and finally aesthetic needs. No anti-social needs are included, since these are not regarded as innate. A need to behave aggressively, for example, is thought to arise only when innate needs are denied or frustrated in some way. The person who is seeking to satisfy an innate need experiences delight and happiness in the process. He enjoys doing what he needs to do (Maslow, 1959).

Although for most people self-actualization is only a hope or a goal, something wished for and striven toward, a few appear to achieve it to a large degree. Maslow studied a group of such persons, although he does not make it very clear just how he chose his sample and carried out his investigations. He did include both historical personages, such as Beethoven and Lincoln, and persons alive at the time of the study, including Einstein and Eleanor Roosevelt. On the basis of his findings, Maslow formulated a list of fifteen characteristics of self-actualized persons (Maslow, 1954). These are as follows:

1. Self-actualized persons perceive reality more effectively than most people do and have more comfortable relations with it. That is, they live close to reality and to nature, can judge others accurately, and can tolerate ambiguity or uncertainty more easily than most people can.

2. They can accept themselves and their various characteristics with little feeling of guilt or anxiety and, at the same time, can readily accept others.

3. They show a great deal of spontaneity in both thought and behavior, although they seldom show extreme unconventionality.

4. They are problem-centered, not ego-centered, often devoting themselves to broad social problems as a mission in life.

5. They have a need for privacy and solitude at times and are capable of looking at life from a detached, objective point of view.

6. They are relatively independent of their culture and environment but do not flaunt convention just for the sake of being different.

7. They are capable of deep appreciation of the basic experiences of life, even of things they have done or seen many times before.

8. Many of them have had mystic experiences such as having felt a deep sense of ecstasy, having felt limitless horizons opening to them, or having felt very powerful and at the same time very helpless but ending with a conviction that something significant had happened.

9. They have a deep social interest and identify in a sympathetic way with mankind as a whole—witness Abraham Lincoln.

10. They are capable of very deep, satisfying interpersonal relations, usually with only a few rather than many individuals.

11. They are democratic in their attitudes toward others, showing respect for all people, regardless of race, creed, income level, etc.

12. They discriminate clearly between means and ends but often enjoy the means toward their ends more than impatient persons do.

13. They have a good sense of humor, tending to be philosophical and nonhostile in their jokes.

14. They are highly creative, each in his own individual way. They have "primary creativeness which comes out of the unconscious" and produces truly original, new discoveries. This shows itself in whatever field the self-actualized person has chosen and is to be distinguished from the kind of productive creativity reflected in art, music, poetry, science, or invention. Of course, the self-actualized person in any of these fields will show both kinds of creativity.

15. They are resistant to enculturation. That is, although they fit into their culture, they are independent of it and do not blindly comply with all its demands.

With all these characteristics self-actualized persons are particularly capable of loving and of being loved in the fullest way. Their love shows great spontaneity and is characterized by gaiety and elation as well as by care and responsibility for the loved one. Their sexual love episodes may be very intense, approaching the level of mystic experiences. In fact, "peak experiences" of various kinds are characteristic of the self-actualized. These are "moments of highest happiness and fulfillment" and may come, in differing degrees of intensity, during various activities—parental experiences, creative activity, aesthetic perceptions, appreciation of nature, or even athletic participation.

Existentialism. Existentialism is another personality theory which emphasizes self-actualization. Although it had its origin in philosophy and literature rather than the clinic, it has given rise to a type of psychotherapy that will be discussed in Chapter 14.

As indicated by its name, existentialism emphasizes the importance of existence—in the sense that man exists first of all and then decides what kind of person he shall be. Man's freedom is absolute and it is his own choices which determine what he shall become, since even refusing to choose constitutes a choice. Existentialism stresses that there are strong irrational impulses in man's basic nature with which he must come to terms. It also emphasizes direct, concrete experience.

The existentialists are particularly opposed to the idea that persons be manipulated, as things are, through science. Instead, people must struggle to live an authentic life in spite of the pressures of a standardized mass society. Thus the existentialists feel that a sort of self-actualization is possible, but they are far less optimistic in their view of human nature than Maslow or Rogers, for example, and they are less specific in their statements of what an ideal personality or an ideal society would be like.

Stimulus-Response Theories of Personality

As already indicated, nonclinical psychologists have generally not been eager to try to formulate full-scale theories of personality. An exception has been the attempt of some psychologists to extend stimulus-response learning theory to explain both personality development in childhood and the changes that take place in psychotherapy. Leading proponents of this approach are Neal Miller and John Dollard, who hold that it is the environment that controls behavior and that innate tendencies are relatively unimportant in personality development. Like Freud, they postulate basic biological drives as a source of motive power, but they emphasize the extent to which the stimuli provided by the environment—especially rewards and punishments—determine what the individual does and hence what he learns. They hold that feelings and motivations as well as overt

behavior can be learned in this way and regard fear as one of the most important learned responses. If a child is punished for saying certain words or for thinking certain thoughts unexpressed in words but apparent from his facial expression, he may come to fear even his own thoughts.

Neurotic conflicts are learned, for the most part, during childhood and primarily as a result of conditions created by the parent. They stem from contradictory cultural demands, which may make submissive behavior appropriate on certain occasions and aggressive behavior appropriate on others. Such conflicts are particularly severe in early childhood because of the child's limited concepts and verbal understanding. Without adequate concepts of the past and the future, he cannot realize that unpleasant experiences will end and thus has no hope and no patience or willingness to wait. Nor can he understand verbal explanations of such concepts. Feeding in infancy, toilet training, early sex training, and training for control of anger and aggression are the four areas in which cultural demands, as interpreted by the parent, are most likely to produce conflicts.

Another personality theorist, Robert R. Sears, agrees essentially with Dollard and Miller but stresses the importance of studying *dyadic units* (groups of two or more persons) since the largest and most significant part of human behavior involves the interaction of people.

Another theorist who emphasizes the role of the learning process in the development of personality is O. Hobart Mowrer. He has developed a dual theory of the nature of learning. Whereas Dollard and Miller regard reward to be essential to all learning, Mowrer holds that this is true only for what he calls *solution learning*, in which the individual acquires a tendency to respond in some particular way in order to solve a problem.

Although the learning theorists owe much to the insights of Freud and other users of clinical observation and intuition, they are firmly committed to the use of experimental methods. They typically begin with the intuitive *conclusions* of the older clinicians and treat them as *hypotheses* to be investigated. Thus their work comes closer than that of their predecessors to meeting the rigorous demands of science.

CLINICAL METHODS OF STUDYING PERSONALITY

Through the years, man has tried to organize and record his understanding of personality in different ways. His earliest attempts were literary and philosophical. This approach probably began with the first thoughtful caveman; it is still apparent in the works of such great writers as Joseph Conrad and Somerset Maugham. Shakespeare, of course, was the outstanding example. There probably is some gold of scientific truth which can be mined from literature, but there is also much dross. The problem is to know which is gold and which dross, since writers are creative, not critical, and certainly do not count, tabulate, or analyze a large number of cases to find the common element. Shakespeare had Julius Caesar say, "Yon Cassius hath a lean and hungry look. . . . Such men are dangerous." Modern research on the problem of somatotypes, as we saw, has revealed this insight as false. Since there is no way to separate the gold from the dross in our great literature, it is highly unreliable as a source of data. Although an occasional attempt has been made (see p. 145) to combine this approach with more objective techniques, it is generally conceded to be of little use in the scientific study of personality.

The second approach to the organized study of personality has been the use of methods of observation which, though crude and imperfect, have given us much more information than the literary and philosophical approach. These are the clinical methods used by psychologists; they consist primarily of the personal interview and the use of projective techniques. These will be explained shortly.

The third and newest approach is quantitative and experimental; it has been in existence only since the turn of the century. Here too, as we shall see in Chapter 5, many false starts were made in the early decades of this century. Quantitative methods, however, have built-in controls that eventually reveal their inadequacies, when they are inadequate, and sharply demonstrate their value when they are in fact valuable. The remainder of this chapter will be

devoted to the clinical methods of studying personality; the following chapter, to the more objective methods.

The Interview

The interview is the central technique used by clinical psychologists and psychiatrists in their attempts to study and treat personality disorders. The theories of personality which have been presented in this chapter are based largely on the analysis of interview data.

The informal interview has also been used extensively by employers in selecting new workers. In this situation, where it is possible to check interview impressions against later actual performance, the interview has proved to be a very dependable device, although it is still widely used by personnel people (Mayfield, 1964).

There are a number of reasons why the interview so often fails to yield good predictions of future behavior. In the following pages we shall examine a number of the weaknesses of this method of obtaining information.

The "halo effect." One source of error in interviews (and also in the quantitative rating scales to be discussed in Chapter 5) is the "*halo effect*." The interviewer cannot completely isolate the behavior being observed from his knowledge of the individual as a whole. A person who is likable, or who is regarded as highly intelligent, and thus makes a "good impression" on the interviewer, is likely to be judged favorably in other respects as well.

Stereotypes. Closely related to the halo effect as a source of error is the effect of *stereotypes*. Stereotypes are preconceived notions as to how people of a given race, national origin, or occupation ought to appear or behave. The stereotype of the Irishman, for instance, includes a keen sense of humor and a readiness to fight at

the slightest provocation. Many people have stereotyped mental pictures which immediately come to mind when someone says "salesman," "politician," "spinster," or "scientist." Although many of these preconceptions have little or no basis in fact, they constantly influence our observations of people's behavior or appearance.

In many social contacts, especially new ones, information about the other person is meager, and our assumptions give us the only basis we have for anticipating both the other person's behavior and his expectations of us (Koltuv, 1962). The danger, of course, is that our stereotypes may act as blinders, hindering accurate perception of others, and that we may be unwilling or unable to change our assumptions even though the objective evidence indicates that they are erroneous.

Psychologists, like other people, are subject to stereotypes. For example, a psychologist who has adopted a certain theory of personality may tend to see only the evidence that supports his theory. This tendency may explain why the patients of Freudian therapists are usually found to have symptoms that fit Freudian theory, whereas the patients of Jungian or Adlerian therapists most often seem to exhibit behavior that fits Jungian or Adlerian theory.

Failure to quantify. Perhaps the greatest weakness of the personal interview as it has been used in both employment and clinical work is the fact that its users seldom sum up their judgments in a concise and objective manner. This failure is not an inherent fault of the interview but rather of the interviewer. It can be overcome to some extent by use of the *standardized interview*, whereby predetermined questions are asked in a prearranged order. Interviews of this type that lead to a quantitative conclusion can be regarded as measuring devices and can be scored and evaluated in an objective manner.

Faulty memory. Part of the weakness of the interview lies with the interviewee. Even if he has no desire to distort or omit information, he may do so through sheer inability to recall accurately.

One recent study investigated the ability of mothers to remember facts about their children. This was a longitu-

dinal study in which records were kept of interviews with nineteen mothers before the children were born, when they were one year old, and again when they were six years old. When the children were between seven and eight years old, the mothers were again interviewed, to determine how the time elapsed since the earlier interviews had affected their memories.

Although there was considerable variation in the memory of the mothers, none of them gave very accurate information. Their recollections appeared to reflect their current picture of the past rather than their actual earlier experiences and attitudes. Memory proved to be better for some kinds of information than for others. "Hard facts," such as the length of the child at birth, were remembered best. Next came the mothers' general attitudes, except those involving anxiety, which were remembered least well. However, anxiety associated with specific experiences or events seemed to facilitate accurate recall of those experiences. Length of time alone was not related to the reliability of their reports (Haggard, Brekstad, and Skard, 1960).

When the interviewer's main concern is with the present perceptions, hopes, and plans of the interviewee, the effects of a poor memory are less serious. Often, for the purpose at hand, the interviewer is primarily interested in how the individual currently perceives himself and the world and what kind of life he would like to live.

Clues from Projective Devices

Recognition of the shortcomings of the interview method of studying personality has caused present-day clinical psychologists to seek better methods. These include projective or "depth" methods and psychometric or objective methods. The latter will be discussed in Chapter 5.

Undoubtedly you have sometimes "seen" a face or the shape of an animal in a cloud. But if you mentioned this to a friend, you may have discovered that he saw a tree or a castle or something else quite different. Psychologists rely upon a similar phenomenon in their use of *projective* techniques of personality measurement. The subject is presented with a standardized set of ambiguous or neutral stimuli—inkblots or pictures which have no definite meaning but can be interpreted in various ways—and

CLINICAL METHODS OF STUDYING PERSONALITY

Through the years, man has tried to organize and record his understanding of personality in different ways. His earliest attempts were literary and philosophical. This approach probably began with the first thoughtful caveman; it is still apparent in the works of such great writers as Joseph Conrad and Somerset Maugham. Shakespeare, of course, was the outstanding example. There probably is some gold of scientific truth which can be mined from literature, but there is also much dross. The problem is to know which is gold and which dross, since writers are creative, not critical, and certainly do not count, tabulate, or analyze a large number of cases to find the common element. Shakespeare had Julius Caesar say, "Yon Cassius hath a lean and hungry look. . . . Such men are dangerous." Modern research on the problem of somatotypes, as we saw, has revealed this insight as false. Since there is no way to separate the gold from the dross in our great literature, it is highly unreliable as a source of data. Although an occasional attempt has been made (see p. 145) to combine this approach with more objective techniques, it is generally conceded to be of little use in the scientific study of personality.

The second approach to the organized study of personality has been the use of methods of observation which, though crude and imperfect, have given us much more information than the literary and philosophical approach. These are the clinical methods used by psychologists; they consist primarily of the personal interview and the use of projective techniques. These will be explained shortly.

The third and newest approach is quantitative and experimental; it has been in existence only since the turn of the century. Here too, as we shall see in Chapter 5, many false starts were made in the early decades of this century. Quantitative methods, however, have built-in controls that eventually reveal their inadequacies, when they are inadequate, and sharply demonstrate their value when they are in fact valuable. The remainder of this chapter will be

devoted to the clinical methods of studying personality; the following chapter, to the more objective methods.

The Interview

The interview is the central technique used by clinical psychologists and psychiatrists in their attempts to study and treat personality disorders. The theories of personality which have been presented in this chapter are based largely on the analysis of interview data.

The informal interview has also been used extensively by employers in selecting new workers. In this situation, where it is possible to check interview impressions against later actual performance, the interview has proved to be a very undependable device, although it is still widely used by personnel people (Mayfield, 1964).

There are a number of reasons why the interview so often fails to yield good predictions of future behavior. In the following pages we shall examine a number of the weaknesses of this method of obtaining information.

The "halo effect." One source of error in interviews (and also in the quantitative rating scales to be discussed in Chapter 5) is the "halo effect." The interviewer cannot completely isolate the behavior being observed from his knowledge of the individual as a whole. A person who is likable, or who is regarded as highly intelligent, and thus makes a "good impression" on the interviewer, is likely to be judged favorably in other respects as well.

Stereotypes. Closely related to the halo effect as a source of error is the effect of *stereotypes*. Stereotypes are preconceived notions as to how people of a given race, national origin, or occupation ought to appear or behave. The stereotype of the Irishman, for instance, includes a keen sense of humor and a readiness to fight at

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◆ An inkblot similar to those used in the Rorschach test. What do you see in it?



is encouraged to interpret freely what he “sees” in them. Thus the subject can “project” onto each neutral stimulus some special, private meaning—much as you projected the face or animal onto the cloud. Psychologists have found that such projections reflect the differing needs and emotional adjustments of individuals and thus help reveal their underlying personality patterns.

Projective tests are difficult to fake because there are no obviously right or wrong answers, and have the further advantage of tapping deeper levels of needs and fears than other measurement methods. They are not, however, entirely satisfactory. One major limitation is that the psychologist must rely to a large extent upon his own subjective judgment in scoring the subject's responses. Although objective standards have been set up for evaluating various types of responses, skillful interpretation on the part of the examiner is still required. This means that the judgment of the examiner influences the final “score” in a way that it does not with more objective tests.

The Rorschach test. The *Rorschach* technique, one of the oldest projective methods, makes use of a series of inkblots. Some are

black and white, some colored, and they vary in form, shading, and complexity. ◆ The subject observes the cards in a prescribed order and describes what he “sees” in each one. This often gives information about the personality structure which is not brought out by clinical interviews. For example, the way a subject reacts to the color in the blots may throw light on his emotional responses to his environment.

Separate scores are made of what the subject sees on the card, where he sees it, and what qualities of the blot caused him to see it. Thus the interpretation of a Rorschach record is highly complex, based on many variables and never on one or two responses alone. This means that it must be used only by workers who have had very specialized training.

Although the test's author probably did not intend the Rorschach to be used for prediction of job success, many of his followers have made unsubstantiated claims for the value of the test in this field. It has failed, however, in predicting vocational success in the case of life insurance managers (Kurtz, 1948) and in numerous other industrial and military settings.

Even when the Rorschach is used to classify mental patients, results are disappointing.

One study was designed to determine how much agreement would be reached between psychologists judging a group of subjects from Rorschach test results and psychiatrists judging the same subjects from clinical case material. A group of fifteen subjects—including normally adjusted persons, neurotics, and psychotics—was used. Qualified psychiatrists judged each subject for overall adjustment on the basis of clinical material. Skilled psychologists judged each subject for overall adjustment on the basis of (1) Rorschach test results and (2) clinical material.

In their findings based on the study of clinical materials, the psychiatrists and psychologists showed a high level of agreement, both within their own groups and with each other. There was also a high level of agreement among the psychologists in their interpretations of the Rorschach results. When the Rorschach findings were compared with those which had been made on the basis of clinical materials, however, almost no agreement was found. In addition to disagreement with the clinical findings of both groups, the Rorschach results failed to indicate which subjects were normal, which neurotic, and which psychotic (Newton, 1954).

This and the numerous other studies like it do not tell us which method gave the wrong results. All we know is that the two methods did not agree. One investigator who tested the value of the Rorschach in predicting the treatment outcome of patients undergoing psychotherapy concluded that, with our present state of knowledge, this device alone is not at all an adequate predictor of how a patient will react to treatment (Filmer-Bennett, 1955).

Extensive examination of studies involving the Rorschach led another investigator to the conclusion that errors and unsound statistical procedures used in validating the Rorschach were so widespread that perhaps 90 per cent of the conclusions published are unsubstantiated (Cronbach, 1949). Largely as a result of Cronbach's objective criticism and in response to his later positive suggestions for needed research (Cronbach, 1957), psychologists have improved their methods of using the Rorschach, with encouraging results (Howard, 1962; Lindzey, 1961).

The Thematic Apperception Test (TAT). Another example of the projective technique is the Thematic Apperception Test (Morgan and Murray, 1935). This test is composed of three series of ten pictures, each picture representing a different situation. The subject is asked to make up a story about each picture, describing the situation, the events that led up to it, how the characters felt, and what the outcome will be. By evaluating both the formal characteristics and the content of these stories, the examiner tries to discover the characteristic thought patterns of the subject.

One recent study has indicated that persons who tend to be dependent—that is, who seek the help of others in making decisions and who fear loneliness—tell TAT stories quite different from those told by independent individuals.

The subjects were twenty-seven psychology students. After they had written brief TAT stories, they were tested for dependency as indicated by tendency to conform to group opinion in an experimental situation in which they had to judge the correct length of certain lines. Each subject worked in a group with four other "subjects" who always gave their opinions first; these actually were stooges instructed by the experimenter to

give incorrect judgments part of the time. The degree of dependency of the experimental subject was measured by the number of times he yielded to the group opinion on the incorrect judgments. Results indicated that every one of the subjects who had told two or more TAT stories in which a principal character sought help from others, or was disturbed by lack of love and support, was a "yielder" in the conformity experiment (Kagan and Mussen, 1956).

In this experiment stories with themes of dependency were most frequently told about a card showing a young man and an older man talking. One story typical of those told by the yielders was the following:

"Bill Johnson was troubled over a problem that he had concerning his girl friend. He spent considerable time pondering on the problem but could think of no logical answer. Finally he sought the help of his father. They talked about the problem for a while and finally the old gentleman arrived at a conclusion. Bill applied the resulting conclusion and found his problem was solved."

Many of the nonyielders, on the other hand, saw the two figures as criminals planning a crime or as a lawyer and his client. Very often feelings of hostility between the figures were described, as in the following story:

"These two people are having an argument about the business in which they are father and son partners. The father has old ideas about doing things and the son has modern methods which he picked up in college. Obviously the partnership will not work because of this. The



■ This child is taking the Children's Thematic Apperception Test, similar to the original TAT but with a series of pictures more suitable for children.

son still holds high regard for his father but refuses to accept his father's ways of doing business. The father still thinks that a plan can be worked out, but through his higher education the son realizes the impossibility due to the business method disagreement." (Kagan, 1957)

Another recent study bears out the assumption of clinicians that in the TAT the individual draws on material from his own experience in constructing his stories. This was an investigation of the contents of the TAT stories given by Negro and white children.

The subjects were fifty Negro and fifty white boys of lower-class status ranging in age from nine to fourteen years. There were many significant differences between the two groups' responses to the TAT. The Negro group saw the general environment as more hostile and indulged in more verbal aggression and hostile thinking than the white boys, but most of their aggressions took a milder form. The Negro subjects rarely saw their characters as establishing and maintaining friendly relations, respecting others, being respected by others, being kind or considerate, or being followed or obeyed by others. The interpreter felt that the Negro boys' general perception of a hostile and threatening world affected their infrequent use of extreme forms of aggression as well as their relative lack of responses indicating a striving for accomplishment and success. On the whole they put more emphasis on passive pursuits such as thinking, reflecting, and speculating (understanding).

The white group, on the other hand, considered the world more warm and friendly. More of their heroes were leaders and respected individuals. They showed greater interest in establishing and maintaining friendly relations and in being kind and considerate of others. The conclusion of the interpreter was that since the white group felt more secure in the world, they felt freer to strive for achievement, to verbalize their extreme hostilities, and to defend themselves against aggression. Though generally more secure, the white boys nevertheless showed more feelings of rejection in the family, especially by their mothers, than did the Negroes. The greater feeling of family security among the Negro boys might result from the customarily permissive treatment of young children by lower-class Negro mothers (Mussen, 1953).

This study demonstrates the need to evaluate "unusualness" of a projective response in terms

of the subject's cultural background and group membership. Responses that are considered unusual if given by a member of one sociocultural group may be typical responses for members of another group. Consistent differences in responses to projective tests may be expected in groups subject to different cultural pressures.

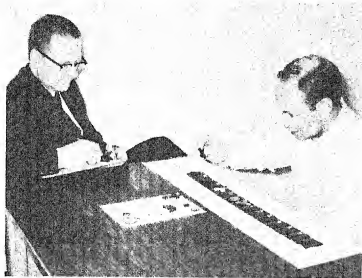
During the past ten years a group of psychologists at Harvard University have conducted a number of studies of achievement motivation (McClelland, Atkinson, Clark, and Lowell, 1953). As a measure of such motivation, they used a modified thematic apperception approach in which groups of subjects were asked to write out story answers to questions about special sets of pictures. The test was represented to the subjects as a measure of intelligence and leadership activity (McClelland, 1961). These stories were analyzed to determine the amount of achievement motivation they indicated, such as success in competition or adequate handling of a difficult job. On the basis of such imagery a *need achievement score* (*n Ach*) was obtained for each subject; this score was taken as a measure of the strength of his motivation to achieve.

The voluminous literature on *n Ach* contains many disappointments and contradictions (Harrison, 1965). Its ability to predict other forms of behavior is low; it does not agree with other methods thought to measure the same thing. These poor results may grow out of the fact that *n Ach* is not a unitary trait such as those revealed by the method of factor analysis, to be discussed in Chapter 5 (Guilford, 1959).

Experience with the TAT in predicting vocational success has also been very disappointing. Both it and the Rorschach proved ineffective in detecting creativity in a group of twenty outstanding artists (Roe, 1946). In another study, the TAT failed to predict which of a group of student pilots would succeed and which would fail (Guilford and Lacey, 1947).

On the other hand, the TAT appears to work well enough to give insight into differences among groups varying in age, ethnic origin, or socioeconomic status, and the like, even though it is not accurate enough for the measuring of individuals (Harrison, 1965). We may conclude, therefore, that the Thematic Apperception Test has the potentiality of being a valua-

◆ In taking the Kahn Test of Symbol Arrangement the subject places the symbols along a felt strip (left). A Japanese psychologist has used the test with subjects in a Buddhist (Japan), an Islamic (East Pakistan), and a Christian (U.S.A.) country in an effort to study the development of cultural traits in the three groups as well as the extent to which they have been influenced by each other. Here he is shown (right, in white helmet) giving the test to a tribal woman in East Pakistan through an interpreter. He has found striking differences from one group to another and at different ages within a group, with considerably more cultural diffusion from other groups evident among the adults than among the children. The Japanese and American subjects showed more similarity than either of them showed with the Pakistani subjects, reflecting the higher level of cultural diffusion between these two cultures (Nakanishi, 1964).



ble aid in studying personality, although it is as yet a dull tool.

The Kahn Test of Symbol Arrangement. A somewhat different type of projective test involves projection of personal needs onto symbols, like hearts, butterflies, dogs, and stars, that have meanings in all cultures. This is the Kahn Test of Symbol Arrangement (Kahn, 1955; Kahn and Giffen, 1960). In this test, the subject is asked to tell what each symbol means to him and to arrange the symbols several times according to different sets of directions. The results are scored in terms of the meanings he himself has assigned and thus do not depend on a prior assumption of meaning on the part of the examiner. The test seems to tap such elusive qualities as creativeness and makes possible an estimate of loss of function resulting from emotional or organic stress (Kahn and Giffen, 1960). Unlike other projective techniques, the KTSA can be administered in fifteen minutes and scored in approximately three minutes and

does not require extensive psychological training on the part of the administrator. It has been used in a number of settings and has been translated into several languages. ◆ Its greatest potential seems to lie in its possible contribution to psychotherapy. The Air Force has used it to evaluate group therapy sessions, and it has been shown to be quite effective in categorizing patients into broad psychiatric classes (Murphy, Bolinger, and Ferriman, 1958).

For example, a member of an Air Force neuropsychiatric team, by interpreting the symbol patterns of forty-eight patients with whom he had no contact was able to classify four fifths of them correctly as schizophrenics, neurotics, persons with behavior and character disorders, or persons suffering from organic psychoses (Murphy, Ferriman, and Bolinger, 1957).

Signs of schizophrenia are particularly clear cut, since the test deals with cultural symbols and schizophrenia involves a distortion of symbolic thinking (Kahn and Giffen, 1960).

There are many other projective tests which cannot be discussed in detail here for lack of space. Among them are the Incomplete Sentences Blank, the Word Association Test, the Rosenzweig Picture-Frustration Test, and the Bender-Gestalt Test.

CHAPTER SUMMARY

Social scientists use the word *personality* to refer to the individual's *social stimulus value*, or effect on others; his *awareness of self*, as a permanent organizing force in his life; or his particular pattern of measurable *traits*.

Four types of explanation used in scientific study are: *deductive*, *probabilistic*, *functional* or *teleological*, and *genetic*. Both the investigator's purpose and the tools and concepts available from previous research influence the type of explanation he will seek. Deductive and probabilistic explanations are those most often sought by *nomothetic* theorists who hope to achieve a full description of individual personality through measurement of traits common in some degree to all people. Functional and genetic explanations are those most often sought by *idiographic* theorists who hold that each individual personality has a unique dynamic structure, and that this structure will not be revealed by any catalog of traits.

A premature attempt at a deductive type of explanation of personality is assessment in terms of physical anatomy, or *morphology*, which has enjoyed wide popularity, although modern research has discredited it. During the nineteenth century a popular form of morphology was *phrenology*, the theory that bumps on the skull indicated the presence of strong faculties or traits.

Another form of morphology is *physiognomy*, the art of judging personality from facial features, still widely practiced. But although there is remarkable agreement as to what traits are supposed to be indicated by certain facial characteristics, there is little agreement between those characteristics and the actual personality

traits possessed, as measured by more objective means. A widely known morphological theory is Sheldon's *somatotype theory*, which has not proved valid for personality assessment.

Other methods of assessing personality are based upon expressive behavior—handwriting, voice, and posture. *Graphology*, now being studied scientifically, has so far proved to be of limited practical value, and little research has been done on other forms of expressive behavior.

Although most experimental psychologists feel that a full theory of personality is premature at this stage of our knowledge, clinicians have developed a number of theories, most of them functional or genetic or both. One of the most influential of these is *psychoanalytic theory*, which has strongly influenced other theories, as well as techniques of therapy. Classic psychoanalysis, as developed by Freud, divides the personality structure into three parts: the *id*, storehouse of instinctive pleasure-seeking impulses of the *libido*, or sexual drive; the *ego*, which controls the expression of these impulses in accordance with the demands of social reality, and the *superego*, or seat of the individual's moral ideas of right and wrong. The ego must compromise the conflicting demands of id and superego. In personality development the individual passes through several stages: the *oral* period, during which satisfactions center around sucking and mouth activities; the *anal*, during which bowel control is achieved; the *phallic-Oedipal*, when signs of sexuality appear and there is a strong attraction to the parent of the opposite sex; the *latency* period during the early school years; and the *genital*, beginning in adolescence, when the person achieves adult sexuality. Traumatic experiences may cause development to be fixated at one of the early stages.

Although recognizing the importance of Freud's emphasis on unconscious processes, sexuality, and childhood experiences, the Neo-Freudians differed from him in placing greater emphasis on the cultural environment and social interaction. Among them Karen Horney stressed the importance of a loving home to prevent the child from developing a *basic anxiety*. Another Neo-Freudian, Erich Fromm, recognizes five basic needs which can be satisfied only in a social environment—the needs for *relatedness*, *rootedness*, *identity*, *transcendence*, and a

frame of orientation, which should be productive. Erik Erikson recognizes eight *psychosocial stages*, each characterized by a particular conflict which must be resolved if future development is to be normal.

Carl Jung, in his *analytical psychology*, emphasized the teleological aspect of personality and extended Freud's concept of the unconscious to include a *collective unconscious* composed of racial memories known as *archetypes*. Jung is responsible for the concepts of *introversion* and *extraversion*. Alfred Adler stressed man's social nature to a great extent, regarding a *striving for superiority* as man's most fundamental motivation. In his early works he thought of this as a selfish "will to power" arising from man's *inferiority complex*, but later he recognized that it could be social in nature, leading to the improvement of mankind. In striving for superiority, each person develops his individual *life style*.

Some psychologists have been influenced by the concept of *field theory* in the physical sciences. Goldstein developed the *organismic theory*, which stresses the orderly unfolding of the inherited potentialities of the organism, with *self-actualization* as man's highest goal. Carl Rogers is an organismic theorist who emphasizes the individual's world of experience, or *phenomenal field*, and especially the *concept of self*, which is a differentiated portion of this field. Both he and Abraham Maslow stress the importance of self-actualization. Maslow studied healthy, self-actualized individuals and listed their characteristics. Self-actualization is also emphasized in *existentialism*, which postulates that man first exists and then chooses what he shall be.

Two who have interested themselves in personality theory are nonclinical psychologists, Neal Miller and John Dollard. They have ex-

tended *stimulus-response* learning theory to explain personality development and personality changes during therapy. They emphasize the importance of the environment in determining how the individual uses his inborn biological drives and hold that feelings and motivations, as well as overt behavior, can be learned, as can neurotic conflicts. Sears has a similar theory, emphasizing *dyadic units*. Mowrer also stresses the role of learning, but regards reward as essential only to *solution learning*. The learning theorists typically treat the intuitive conclusions of the older clinicians as *hypotheses* to be investigated.

Personality may be studied by quantitative and experimental methods or by *clinical methods*, primarily the personal interview and projective tests. The *interview* is the central technique used by clinical psychologists and psychiatrists and yields considerable information. However, it is subject to error from the "halo effect," *stereotypes*, *failure to quantify* information, and *faulty memory*. The *standardized* interview is more objective than the informal interview.

Projective techniques tap underlying levels of needs and fears and are difficult to fake, but they require very skillful interpretation and their results depend largely on the subjective judgment of the examiner. The *Rorschach test*, which employs inkblots, has yielded conflicting results in tests of its validity, and its use is declining. In the *Thematic Apperception Test*, the subject makes up stories based on pictures. A modified form of it has been used to obtain a *need achievement* score. Both the TAT and *n Ach* have proved disappointing. The *Kahn Test of Symbol Arrangement*, which is simpler to administer and score than the other projective tests described above, has been found quite effective in categorizing mental patients.

Outline

VALIDITY
RELIABILITY
OBJECTIVITY
STANDARDIZATION
TYPES OF MEASURING DEVICES

THE NORMAL DISTRIBUTION
MEASURES OF CENTRAL VALUE
MEASURES OF VARIABILITY
PARTILES
CORRELATION

THE PHILOSOPHICAL APPROACH
THE FACTOR-ANALYTIC APPROACH

RATING SCALES
BEHAVIOR SAMPLING
SELF-INVENTORIES

BINET'S EARLY SCALE
THE STANFORD REVISIONS
PERFORMANCE TESTS
THE WAIS AND THE WISC
THE MEANING OF IQ IN TERMS OF BEHAVIOR
DOES THE IQ REMAIN CONSTANT?

FACTOR ANALYSIS
GUILFORD'S STRUCTURE OF INTELLECT

THE RELATIVE CONTRIBUTIONS OF HEREDITY AND
ENVIRONMENT
THE INFLUENCE OF CULTURE
LIFE CONDITIONS INFLUENCING INTELLIGENCE

PSYCHOMOTOR ABILITIES
ATHLETIC ABILITY
MUSICAL ABILITY
ARTISTIC ABILITY

UNDERSTANDING THE WHOLE PERSON

PROFILES
THE MEETING OF THE WAYS

Chapter 5 Psychometric Approaches to Personality

Increasing numbers of modern psychologists are becoming disenchanted with an uncritical dependence upon the clinical approach to an understanding of personality, finding it weak in two important respects. First, the clinical approach has been used mainly with the mentally ill—not with normal persons. Secondly, the early clinicians were not interested in quantitative measurement. Although some modern clinicians have tried to use more quantitative methods, their theories of personality remain based on verbal descriptions of individual cases—leading to inferences that are hard to check objectively and that differ greatly from one theorist to another. As one psychologist so very aptly puts it:

"When Jung tells that patient X became more and more out of touch with his 'archetypal unconscious,' no measurements are offered to demonstrate it, such as we would require if a doctor argued that a patient's illness arose from a continual elevation of his blood sugar. These writers gained a huge popular following, in an audience extending from playwrights to anthropologists and medical men, with theories often based on description of a single case and where the very description failed to agree with that by others." (Cattell, 1965, p. 15)

As a result of these weaknesses, many psychologists have turned to the development of more quantitative and objective methods of study. This is called the *psychometric* approach. It is the view of these psychologists that out of an objective study of various personality traits and their complex interrelations will evolve a more adequate overall picture of personality than would otherwise be possible. Before attempting to understand the use of the objective measuring devices developed by these psychologists, we must take up the basic con-

cepts and mechanics of measurement and the interpretation of objective scores. A more complete discussion of the elements of statistics and an introduction to some actual computations will be found in Reference Manual Section A.

WHAT MAKES A GOOD MEASURING INSTRUMENT?

In developing or using any measuring instrument, the psychologist must answer the important question: does the device really measure what it is intended to measure—that is, is it *valid*? A necessary (but not sufficient) condition for validity is that the device give scores which are consistent, so that the same subject would score the same way if he were tested or observed again under the same conditions. An instrument that gives consistent scores is said to be *reliable*. But in order to be reliable, a measuring instrument must be *objective*, so that two or more individuals can score the subject's responses and obtain the same result. Finally, if the subject's score is to impart any meaningful information, it must be interpretable in relation to the scores of other individuals in a defined group. This is accomplished through *standardization*. Though we need not go into the techniques by which these aims are accomplished, it is important to understand these four concepts and the relationships among them.

Validity

The index of validity is the extent to which the instrument accomplishes the purpose for

which it was intended. Thus, if a psychologist devises a test of mechanical aptitude and discovers that persons who get high scores on the test are nearly always successful as mechanics whereas those who get low scores are nearly always unsuccessful, he may be relatively sure that his test is valid. It takes time to determine the validity of such a test. Applicants must be tested, hired, and put to work. After a period of time, their performance on the job is measured and a comparison is made to determine whether those who made the best test scores are the ones who do best on the job.

Validity is always specific to a particular purpose. That is, a good measuring instrument is not "valid" in the abstract but valid only for a *specified purpose*. For example, a test may be valid for selecting salesmen but invalid for selecting scientists.

When we are making physical measurements, validity usually poses no great problem. It is obvious enough that a yardstick measures length and that a thermometer measures temperature. But in measuring psychological characteristics, it is much harder to establish validity. For example, a test designed to measure innate intelligence may not eliminate the factors of poor schooling and impoverished conditions in the homes of some subjects, and thus scores may reflect these factors as well as intelligence.

Reliability

The reliability of a measuring instrument is the degree to which people earn the same relative scores each time they are measured. If it is a matter of chance whether a subject does well or poorly on the measuring device, we say that it is unreliable. Of course, if the person tested varies between tests due to fatigue, boredom, or worry, such changes in scores are not the fault of the measuring instrument.

A measuring device cannot be valid unless it is first of all reliable, but reliability in itself does not guarantee validity. That is, the fact that a subject makes the same score on a given test each time he takes it does not necessarily mean that the test is measuring what it purports to measure. Reliability is merely a means to the end of validity.

Objectivity

One of the most common causes of unreliability in a psychological measuring instrument is the inclusion of items which must be scored on the basis of subjective judgment. Such items lack objectivity. To be reliable, a measuring device must be set up in such a way that two or more persons can score the responses and get the same results. In many methods of personality assessment, people instead of instruments must, in effect, act as the measuring stick, making it almost impossible to obtain an accurate, objective measurement uncolored by personal feelings and attitudes. As we saw in Chapter 4, this is a weakness of most projective devices.

Standardization

To be useful, a measuring device must be standardized—that is, administered under standard conditions to a large group of persons who are representative of the individuals for whom it is intended. This is done in order to obtain *norms*, or standards, so that an individual's score can be compared with the scores of others in a defined group. If, for example, a measuring device is to be used to classify inductees in the army, the representative sample may be drawn from the general population. But an instrument that is going to be used to select applicants for admission to college must be standardized on college students. If sex differences influence results, norms for the two sexes should be provided separately. In some instances age-group norms are required. Obviously, the statistical tabulation of scores will be meaningless unless all subjects understood the directions and worked under the same time limit on the same test content.

Types of Measuring Devices

Psychological measuring devices in general use in the English-speaking countries fall into three broad categories—*measures of achievement*, *measures of aptitude*, and *measures of motivation*. Measures of achievement tell us how well an individual has learned a particular

task; they are familiar to all students in the form of subject-matter examinations. Measures of aptitude tell us how well a person can learn a particular skill if given the opportunity and if motivated to do so. Measures of motivation, which involve such things as interests, temperament, and values, tell us how interested a person will be in learning a given skill or complex of skills if given the opportunity. Achievement, aptitude, and motivation are, like physical

traits, all regarded as aspects of personality.

Psychological measuring devices may also be classified on the basis of form into six kinds: *interviews* and *projective techniques*, which have already been discussed, and the more objective *rating scales*, *behavior samples*, *self-inventories*, and *tests*. Almost without exception, measures of achievement and aptitude are tests or behavior samples. Measures of motivation make use of all six kinds of instruments.

INTERPRETING SCORES

The raw numerical score earned on a test, rating scale, or other measuring device means nothing in itself. If you make 98 points on an arithmetic test and only 50 points on a vocabulary test, you are not necessarily justified in saying that you are better at working problems than at defining words—there may have been more items on one test than on the other, or the items on one test may have been much more difficult. Before comparing your performance on the two tests it would be necessary to convert these scores, called *raw scores*, into comparable terms. There are several ways of doing this, but first it is necessary to become familiar with a few basic concepts used in measurement and statistics.

The Normal Distribution

Traits are not “all-or-nothing” characteristics. Individual differences result not from the presence or absence of certain traits but rather from their being present in varying amounts in each person. For example, if we should measure a large group of men for the physical characteristics of height, the individual measures (or “scores”) would range along a continuous scale from that of the shortest person to that of the tallest. If the group were typical, there would be a few extremely short persons and a few extremely tall ones, but most of them would be about average in height.

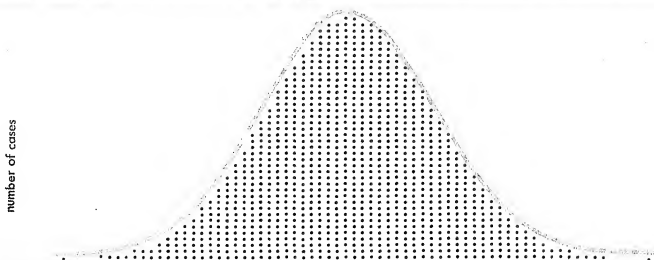
A convenient way to organize and show such data is in the form of a graph with the scale of whatever is being measured along the base line, or horizontal axis. The vertical axis represents the number of individuals that have a trait value. Since most individuals fall near the center of the distribution, the curve is highest in the middle and tapers off toward both extremes, taking the form of a roughly symmetrical, “bell-shaped” curve, similar to the one shown on page 140. Such a curve represents what is called a *normal distribution*. It is the sort of curve usually found when biological or psychological traits are measured in a large, unselected population.

Measures of Central Value

In psychological measurement, as in physical measurement, we use a numerical value to represent *degrees* of something. This always implies that the individual is so many degrees above or below some certain point. When we look at a Fahrenheit thermometer and see that the temperature is 75 degrees, we know that this means 75 degrees above the zero point, which has been arbitrarily designated at 32 degrees below the freezing point of water. But just approach a resident of North Dakota in January and ask him if zero represents the lowest point on the thermometer! In such a rela-

THE "NORMAL" CURVE

This is the distribution of scores that would be expected if 1000 randomly selected persons were measured on weight, IQ, or some other biological or psychological trait. Each dot represents an individual's score. Usually only the resulting curve at the top is shown, since this indicates the frequency with which each measure occurred. Curves actually obtained, of course, only approximate this curve but come remarkably close to it.



tively simple measuring instrument as our thermometer, zero has been set at a point that does not represent the true point of origin—that is, the complete absence of heat, which is the absolute zero of the physicist.

It is impossible to determine a point on test scores that would represent "zero ability" or "zero amount" of a trait. For instance, a child might make a numerical score of zero on a test designed for superior adults, but this would not mean that he had no ability. Because of the practical difficulties involved in determining a zero point, psychologists have given it up as a basis for comparing test scores. Instead they use a central value as an arbitrary origin. Thus an individual can be described on the basis of how far above or below the average score for the norm group he is in the particular trait measured. The three most common measures of central value used by psychologists are the *mean*, the *median*, and the *mode*.

The arithmetic mean. The most common measure of central value used by psychologists is the familiar average, technically known as the *arithmetic mean*, or merely the *mean*. The

mean of a group of scores is computed simply by adding them up and dividing their sum by the number in the group. To compute the mean score of a class on the final examination, you would add all the scores together and divide by the number of people who took the exam. The answer, then, could be taken as the average final examination score for the class.

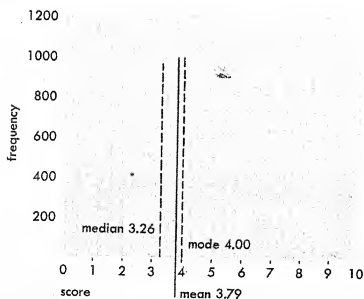
The median. If a distribution of scores follows the normal, bell-shaped curve, the mean is probably the best measure of central value. Sometimes, however, there are a few very high or very low measurements that make the curve *skewed* (lopsided). These will have a great effect upon the value of the mean. For instance, the president and a few officers of a company might make in the neighborhood of \$100,000 per year. If their salaries were included in computing the mean salary of all employees in the company, the result would be considerably higher than what most people would consider the typical employee salary. One solution would be to leave out the president and vice-presidents when computing mean salaries, but then it could be argued that after all, these peo-

ple are employees and to leave out their salaries would give a wrong picture too.

A good answer would be to find the salary figure which splits the distribution exactly in half. That is, find the middle salary figure, the one which exactly one half of all the employees surpass and the other half fall below. Such a figure is called the *median*. If the distribution is symmetrical, as it is in a normal distribution, the median will be equal to the mean. However, if the distribution is lopsided with a few very high scores or a few very low ones, the median will be less affected than the mean by the values of these extreme scores. This is because the mean takes account of the exact *value* of each score, whereas the median treats each score as *one* unit above or below a central point.

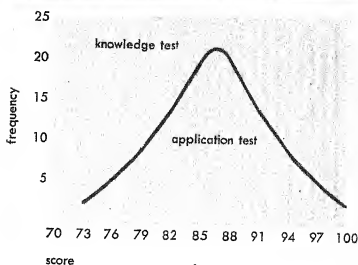
The mode. A less frequently used measure of central value is the *mode*. The mode is the measurement which occurs more frequently than any other measurement in the distribution. On an examination, for example, if more people score 78 than any other score, 78 is the mode. In a normal distribution, such as that shown on page 140, the mode is equal to the mean and the median. Therefore, when a distribution is believed to be normal, it is reasonably safe to use the mode as a quick estimate of the mean.

SKEWED CURVE



SAME MEANS—DIFFERENT RANGES

These are hypothetical curves of the performance of the same 100 students on two tests. For the sake of simplicity, we have assumed symmetrical distributions in both cases and the same mean.



Clearly, you need to know something about the type of distribution in a given case to know which measure of central value is most representative of the group as a whole. And conversely, you need to know which measure of central value has been used before you can interpret a statement in the news about "average" salaries or "average" production or "average" anything else.

Measures of Variability

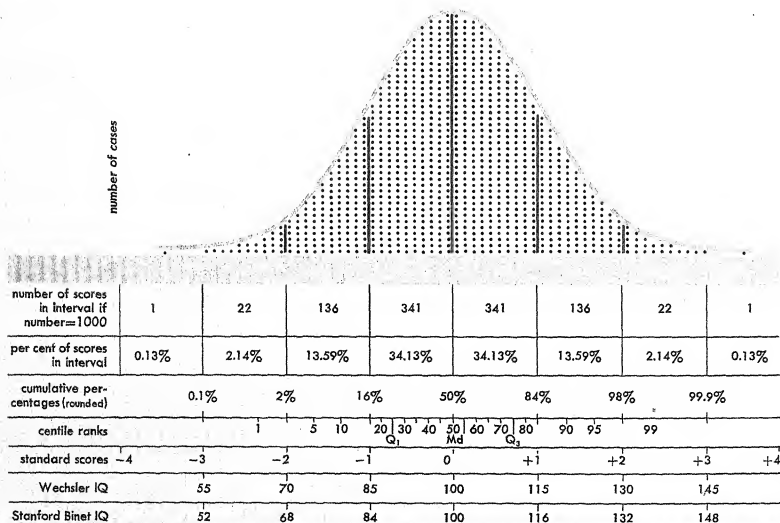
To describe a distribution of scores, it is necessary not only to know the central value of those scores, as indicated by a measure of the central value, but also to have a measure of their spread, or *variability*. The variability of a distribution shows us the extent of individual differences present in the group. If the individuals are all just about alike in the trait being measured, their scores will bunch up very close to the mean. If there is a great deal of difference among them, their scores will be more spread out. For example, 100 students might get scores over a narrow range on a test of psychological knowledge and over a wide range on a test of ability to apply principles.

The simplest measure of variability is the difference between the highest and lowest score. This is called the *range*. Unfortunately, the range is a poor measure of variability because it is too dependent upon the size of the sample: there is a greater chance of obtaining extreme scores in a large sample than in a smaller sample drawn from the same group. For this reason, a measure of variability has been developed which is not dependent upon the size of the sample. This measure is called the *standard deviation*. The numerical value of the standard deviation is an indication of how closely scores are clustered around the mean: the larger the standard deviation, the wider the spread of scores.

We are not concerned here with the way the standard deviation is calculated but only with what it means. Look at the figure, which is the same as the one on page 140 except that lines have been added showing the size of the standard deviation. The standard deviation represents a certain distance along the base line of the curve. The line in the center of the distribution is at the mean, which is denoted by the symbol \bar{X} . The other vertical lines are all spaced one standard deviation (s) apart. Thus, the line at $+2s$ is two standard deviations above the mean.

The first row of numbers below the distribution shows how many scores are located in each section if the total sample is 1000. Notice that

THE "NORMAL" DISTRIBUTION OF SCORES



there are 682 scores between the point which is one standard deviation below the mean and the point which is one standard deviation above the mean. This means that approximately 68 per cent of all scores fall within one standard deviation to both sides of the mean. This is true of any normal distribution. Notice also that practically all the scores fall within three standard deviations of the mean.

Often it is convenient to think of a person's score on a test in terms of the number of standard deviations it is above or below the mean. This is called his *standard score*. If a person's raw score is two standard deviations above the mean, his standard score is $+2.00$. If he is one and one-half standard deviations below the mean, his standard score is -1.50 . By using standard scores, an individual's results on different tests can be compared directly. If he has a standard score of $+1.75$ on an English test and $-.30$ on an arithmetic test, we can safely say that he is better at English than he is at arithmetic. The position of the various standard scores is indicated in the figure on page 142.

Partiles

As we have seen, the median divides a distribution into halves: half the scores are above the median and half are below it. The distribution could also be divided into quarters, with one fourth of the scores falling in each quarter. There is no limit to the number of equal parts into which a distribution may be divided. The points which divide a distribution into a number of equal parts are called *partiles*. If the distribution is divided into quarters, the division points are called *quartiles*; if it is divided into hundredths, the division points are called *centiles* (or sometimes *percentiles*). The centile is the most commonly used partile. As with other partiles, the different centile points are numbered from the bottom to the top: 1 per cent of the scores are below the first centile; 10 per cent are below the 10th centile; 75 per cent are below the 75th centile; and so on. In the figure on page 142 the cumulative percentages, when they are whole numbers, correspond exactly to centiles.

Centiles are a convenient way of presenting the results of test standardization for use in understanding individuals. A table is usually set up showing the raw scores which are equivalent to centile points. Then instead of reporting an individual's raw test score, the highest centile point which he surpasses is reported. Thus, instead of saying that an individual scored 142 on a certain test, one would say that the individual was "at" the 67th centile or the 83rd centile or whatever other centile point was just below a raw score of 142. To say that an individual's score is at the 67th centile is another way of saying that 67 per cent of the individuals taking the test obtained scores below his.

In a normal distribution, centile points can also be used to interpret standard deviations. Just as the median (50th centile) is always equal to the mean in a normal distribution, a given centile is always the same number or fraction of standard deviations above or below the mean of a normal distribution. The relation between centiles and standard deviations is shown in the figure on page 142.

Correlation

It is often valuable to know whether or not traits go together. Are highly intelligent persons more introverted, more mechanically minded, or taller and stronger than less intelligent ones? To answer this question we would first measure a group of people in intelligence and in whatever other traits interested us and then see to what extent the intelligence scores were related to—that is, correlated with—the scores in other traits.

When we speak of correlation, we mean the *average* relationship found between two traits in a group of people. If we found, for instance, that tall people were usually higher in intelligence than short ones, we could say that there was a positive correlation between height and intelligence. If the two traits correlated *perfectly* and *positively*, we could line up all the individuals of the group according to height and find that they were also lined up perfectly according to intelligence. If we found that intelligence was greater in short people and decreased with height, we would say the correlation be-

tween the two traits was *negative*. If tall people were neither more nor less intelligent than short ones, we would say there was no correlation between the two traits, meaning that knowing a person's height would give us no clue to his intelligence.

The numerical value that shows the degree of relationship between two sets of scores made by the same persons is called the *correlation coefficient*. Correlation coefficients range from -1.00 to $+1.00$. A coefficient of -1.00 means that there is a perfect negative correlation between the two groups of scores. That is, the highest scorer on one test is the *lowest* scorer on the other test. A coefficient of $+1.00$ means just the opposite: there is a perfect positive correlation and the highest scorer on one test is the highest scorer on the other test, with the second highest scorer on one test also the second highest scorer on the other test and so on down to the lowest scorer. If there is a perfect correlation, either positive or negative, between two tests—a rare occurrence in psychology—it means that if we know a person's score on one test we can predict his score on the other test with perfect accuracy. The higher the correlation coefficient, either positive or negative, the better the prediction that can be made. If the correlation coefficient is zero, no increase in the accuracy of prediction over a sheer guess can be accomplished.

The correlation coefficient in prediction. Suppose that you want to predict an individual's success in a vocabulary test knowing that he made an above-average score in a spelling test and that the correlation between the two tests is $+.90$. You cannot read this correlation coefficient directly as a percentage, but you can translate it into a percentage for prediction purposes. In effect, you would be asking the question: what percentage of those who make high spelling scores will also make high vocabulary scores when the correlation coefficient of the two abilities is $+.90$? If the correlation coefficient were $+1.00$, as we have seen, 100 per cent of those who made high spelling scores could be expected to make high vocabulary scores. If the coefficient were zero, meaning that there was no relation between the two abilities, 50 per cent of those who score above the

median on the spelling test would, by the laws of chance, score above the median on the vocabulary test. Statisticians have determined what percentage of those who fall in the upper half of the distribution in one trait can be expected to fall in the upper half of the distribution of another when there is a given correlation between two normally distributed traits (Taylor and Russell, 1939). Below are representative correlation coefficients and their corresponding percentages:

Correlation coefficient	Per cent of better half on Test A who will fall in better half on Test B
.00	50
.05	52
.10	53
.20	56
.30	60
.40	63
.50	67
.60	70
.70	75
.80	80
.90	86
.95	90
1.00	100

As you can see from the table, the accuracy of prediction varies with the degree of correlation between the two variables being considered.

Knowing that the correlation between two tests is $.90$, you can predict that 86 per cent of those who were in the upper half on the spelling test will also be in the upper half on the vocabulary test. But 14 per cent will not be, and there is always the possibility that the particular individual you are concerned about is among this 14 per cent. Thus in predicting a particular individual's score, the most you can do is indicate a probability. In this case, you can say his chances of being in the upper half on the second test are 86 out of 100.

The correlation coefficient as a measure of test validity and reliability. As we have seen, the validity of a test is the extent to which the test measures what it is supposed to measure. The correlation coefficient is an excellent statistic to

summarize this relationship. Thus, if a college entrance test is used to predict students' success in college, you can assess its validity by seeing how well their scores on it correlate with their later grade-point averages. A high positive correlation between test scores and grade-point averages indicates a high validity for the test.

The correlation coefficient can also be used to measure the reliability of a test. If two equivalent forms of the same test are administered, the individuals' scores on one form can be correlated with their scores on the other form. The correlation coefficient will show the degree to which individuals have the same relative standing each time they are tested. If the coefficient is positive and high, the test is highly reliable.

Correlation and causation. As we have seen in preceding chapters, we must be wary in drawing conclusions from correlational studies. A high correlation between two traits does not necessarily mean that one causes the other. It is possible that this is the case, but it is also possible that both are caused by a third factor. For example, psychologists learned decades ago that personal adjustment scores obtained on certain types of temperament tests predict success or failure in management jobs. But it cannot be concluded that the poor personal adjustment causes the poor management performance. It is possible, for example, that failure on a previous job causes both poor personal adjustment and poor performance (Kirchner, 1963).

APPROACHES TO PERSONALITY MEASUREMENT

In the objective measurement of personality, one of two general approaches may be employed. In some cases a psychologist starts with traits he is interested in, such as amiability or aggressiveness, and tries to create scales for measuring them objectively. Another psychologist may begin by recording responses to many questions or stimulus situations or by obtaining ratings on many types of behavior and then analyze the scores to determine what unitary factors are being tapped by the various measures. Thus one starts with meaningful traits derived from commonsense observation or intuition and defined by certain types of behavior in real-life situations; the other proceeds empirically, starting with objective measures of behavior and deriving "traits" or "factors" by statistical analysis. A classic example of each approach will be described in this section.

The Philosophical Approach

The philosophical approach to personality study is based on a broad view of man as his na-

ture is revealed by history, literature, and general observation. Some psychologists have attempted to unite the philosophical approach with that of objective measurement. A good example of this is found in the Study of Values test (Allport, Vernon, and Lindzey, 1960). The Study of Values is a self-inventory devised to measure the relative importance of six basic motives in an individual's personality: *theoretical, economic, aesthetic, social, political, and religious*. This classification is based directly upon Eduard Spranger's *Types of Men*, a brilliant work which presents and defends the view that the personalities of men are best known through a study of their values or "philosophy of life" (Spranger, 1928).

Questions are included in this test which define the following types in terms of what people think is worth while in life.

1. *The Theoretical.* The dominant interest of the theoretical man is the discovery of *truth* for its own sake. In the pursuit of this goal his greatest aim in life is to find order in the world and to systematize his knowledge. He tends to be critical and rational and to enjoy theorizing.

Scientists, philosophers, and scholars test high in theoretical values.

2. *The Economic.* The economic man is interested in the *useful*. This type is thoroughly "practical" and conforms well to the prevailing stereotype of the average American businessman. Business executives and salesmen are usually high in this factor.

3. *The Aesthetic.* The aesthetic man finds his highest value in the appreciation of *form* and *harmony* and normally has little interest in the theoretical or the practical. He need not be a creative artist, nor need he be effete.

4. *The Social.* The man with strong social values or motives has a great deal of affection for *people* and tends to be sympathetic, kind, and unselfish. He gets satisfaction from helping others. In the extreme, this may lead to sentimentality and inability to deal with human problems realistically. On the other hand, those who have very low social values tend to be cold and impersonal. Social workers, teachers, and members of the clergy of all faiths tend to be high in social values.

5. *The Political* (power values). The political man mainly wants *power* over others which he uses to his own ends, not to help people. He is primarily interested in managing others and controlling their activities. Leaders in all fields, salesmen, executives, and high military officers tend to score high on this factor.

6. *The Religious.* The highest value of the religious man is *unity*. Those who score high on this factor tend to be religious in the broadest sense, although they may not belong to any particular religious group and may not participate actively in formal religious activities. They tend to have high ethical values and a somewhat mystical attitude toward life.

7. *Mixtures.* Spranger did not suggest that a given man belongs exclusively to one or another of these value types. Thus a "star salesman" is likely to be high in economic and political values, low in aesthetic and social values, moderate in theoretical and religious values.

The Factor-Analytic Approach

The last thirty years of research into the structure of personality have at last provided

psychology with a number of meaningful dimensions which are derived from objective measurement. Mainly in the last ten years this approach has begun to yield clear and concise results, largely through the use of *factor analysis*. The use of factor analysis in identifying ability factors will be discussed later in this chapter.

Two large groups of normal personality factors have been identified by this technique. These have been called *hormetic* and *temperament* factors (Guilford, 1959). The *hormetic* traits are the direct motivational aspects of an individual's personality and depend both upon the physical needs of the body, which will be discussed in Chapter 11, and upon the kinds of experience the individual has had. The *temperament* traits of an integrated person describe the *manner* in which the individual characteristically operates in certain areas, just as his aptitude traits tell us how well he can be expected to perform if he has the proper motivation and training.

Both groups of factors have been identified using mid-twentieth century American subjects. We do not yet know the extent to which they are created by our particular culture or the degree to which they represent common denominators in the human species that would be found in people living under other cultures. Certainly the exact form such factors take would be expected to vary greatly from one type of culture to another.

Hormetic factors. Needs, attitudes, and interests have been called the *hormetic* dimensions of personality. The word comes from the Greek, meaning "to have a purpose" or "to strive." Careful work by Guilford, Cattell, Eysenck and many others over the years has revealed a number of measurable needs, attitudes, and interests which serve to direct our behavior and consciousness and to keep us busy seeking until some goal is reached. Several of these are shown in the chart (Guilford, 1959). The present list is by no means exhaustive, and research in this area continues. Other psychologists are working in the same field, and it is interesting to note that their findings are in essential agreement—a situation quite different from that which has often arisen among those us-

THORNTON FACTORS

Type of factor	Factors identified
Need factors	organic condition: male sex drive general activity
	environmental: need for a soft environment need for orderliness need for attention
	achievement: general ambition persistent effort endurance
	self-determination: need for freedom self-reliance vs. dependence cultural conformity honesty
	social: gregariousness benevolence need for discipline aggressiveness
Attitudinal factors	liberalism vs. conservatism
	religionism
	humanitarianism
	nationalism
Vocational interest factors	gradualism vs. revolution
	professional level: scientific esthetic expression social welfare
	commercial: business clerical
	physical activity: mechanical outdoor aviation
	interests unique to women: career-women domestic mathematical
	overt activities: liking for adventure vs. security liking for diversions
	activities with certain properties: liking for variety liking for precision
Avocational interest factors	appreciative: general cultural interests esthetic appreciation
	interest in thinking: reflective outistic rigorous

ing less objective approaches. (Cattell, 1965; Eysenck, 1960).

Temperament factors. J. P. Guilford and his associates have long studied factors of temperament. The Guilford-Zimmerman Temperament Survey is a self-inventory device that has grown out of this research (Guilford and Zimmerman, 1949). Each trait is conceived as a bipolar factor; the individual's score falls somewhere on a scale between positive and negative extremes. His "profile" of high and low scores on the nine dimensions measured can be helpful in predicting his probable success in various jobs, as shown on page 175.

While this test provides measures of nine traits, it is important to keep in mind that no trait stands alone. Each is conditioned and modified by all the other traits and characteristics of the individual. For example, a person very high in ascendance and at the same time high in friendliness would have a vastly different personality from that of a person who was equally dominant but low in friendliness.

General activity (slow-energetic). A high score indicates a high level of activity. Persons scoring high on this factor need activity, must be doing something. A high level of energy tends to exaggerate other personality characteristics. Thus, the sociable person who has a great deal of energy engages in more social activity than the person of lower drive. Less desirable personality traits, such as hostility towards others, will also be more obvious in a person who has a high level of energy. A high level of energy is important to executives, salesmen, production supervisors, etc., but might be a handicap for sedentary workers.

Restraint (impulsive-restrained). Very high restraint means that the individual is likely to be overcontrolled, stiff and lacking in spontaneity in his relations with others. Very low scores suggest serious lack of control, impulsiveness, ill-considered actions and speech. A good level of control is needed in the executive, in the supervisor, and in such technical occupations as engineer, accountant or scientist. Sales jobs which require spontaneity in personal relations with others, on the other hand, require that the person have a lower score on self-restraint. Very low scores on this factor may or may not

indicate serious personality difficulties, depending upon the strength and patterning of other personality factors.

Ascendancy (timid–self-assured). High scores indicate confidence in personal contacts with others and a desire for the leadership role. Low scores suggest lack of confidence in social situations, lack of aggressiveness, or even fear of others. Executive, sales and supervisory positions require a rather high level of dominance, but high scores are not desirable in positions in which there is no opportunity to dominate, control, or lead others.

Sociability (solitary–sociable). High scores indicate a liking for face-to-face personal contacts with others. Low scores suggest a lack of social confidence, lack of interest in social contacts and probable preference for working alone. Those who score low on this trait are not likely to be thought of as friendly persons. Those who have to work with people should not have low sociability scores. However, extremely high sociability scores are not necessarily a good indication for sales, executive, or supervisory personnel since it is important that persons in these positions not be socially de-

pendent—that is, overly concerned with the opinions of others.

Emotional stability (easily upset–emotionally stable). A high score indicates a good, healthy mental attitude and freedom from excessive neurotic tendencies. Low scores suggest moodiness, instability of emotional life and neurotic tendencies.

Objectivity (oversensitive–objective). A high score on this factor indicates a realistic view of self. Persons with high scores do not get their feelings hurt easily, while those who make low scores are sensitive, touchy and easily offended. Extremely high scores on this factor may indicate lack of sensitivity to the feelings of others.

Friendliness (resistant–agreeable). A very high score may indicate pacifistic tendencies, a good adjustment to daily annoyances, or a wish to please others. A low score indicates a tendency to react defensively or belligerently toward others. The seriousness of extremely high or low scores on this factor depends upon other personal characteristics, such as dominance, sociability and self-restraint. Generally speaking, persons with high scores tend to be cooperative,

A MATRIX OF TEMPERAMENT FACTORS

KIND OF DIMENSION	AREAS OF BEHAVIOR INVOLVED		
	General	Emotional	Social
Positive vs. negative	confidence vs. inferiority	cheerfulness vs. depression	ascendancy vs. timidity
Responsive vs. unresponsive	alertness vs. inattentiveness	immaturity vs. maturity	socialization vs. self-sufficiency
Active vs. passive	impulsiveness vs. deliberateness	nervousness vs. composure	social initiative vs. passivity
Controlled vs. uncontrolled	restraint vs. rathymia	stability vs. cycloid disposition	friendliness vs. hostility
Objective vs. egocentric	objectivity vs. hypersensitivity	poise vs. self-consciousness	tolerance vs. criticalness

agreeable and "easy to live with," while those with low scores are most likely to be quarrelsome, critical, and antagonistic in situations in which they feel they can get away with it.

Thoughtfulness (superficial-reflective). A high score indicates a tendency toward reflective and thoughtful behavior. Extremely low scores usually indicate frivolous attitudes and dislike for situations requiring deep, prolonged analytic thinking. Executives, supervisors and those who have positions requiring planning, organization and a good deal of thoughtful analysis should not have low scores on this factor. Scores on this factor must be interpreted in the light of all other personality traits.

Personal relations (critical-trusting). A high score on this factor indicates a tolerance of others, an acceptance of society's mores and customs. A low score suggests suspiciousness and a critical, cynical attitude toward people and society. High scores on this trait are extremely desirable in sales and supervisory personnel or in any position requiring the ability to handle or get along well with people.

Further work by Guilford in this area has resulted in the identification and isolation of fifteen dimensions of temperament (Guilford, 1959). These involve three different areas of behavior—general, emotional, and social—and can be classified according to five general kinds of traits, as shown in the chart.

QUANTITATIVE DEVICES FOR PERSONALITY ASSESSMENT

An obvious method for finding out about an individual's personality is to see what he is like in action. One way to do this is to ask someone who knows him to rate his behavior; another is to place him in a real-life situation and watch what he does. A third method is to ask the individual for information about himself.

Rating Scales

Supervisors, teachers, or others who have had an opportunity to observe an individual over a period of time may be asked to record their impressions on a *rating scale*, a device which is particularly valuable in assessing social stimulus value. There are two kinds of rating scale, *relative* and *absolute*, each with certain advantages and disadvantages. These are frequently used in connection with an interview as well as to record subjective impressions based on a longer period of contact. Both types have the advantage of yielding numerical values that can be analyzed quantitatively.

Relative rating scales. A relative rating scale may be used when several subjects are being

considered. The order-of-merit method is typical. A judge ranks the subjects in order (first, second, third, etc.) by picking out the best and then the next best and so on until all subjects have been ranked on the trait being measured. This method indicates what each person's position is relative to that of all other subjects being considered. Its practical disadvantage is that the judge must keep the entire list of persons in mind throughout the rating process. This difficulty can be reduced somewhat by writing the names of the persons being ranked on cards and having the judge cast the cards into several piles as, for example, good, average, and poor. The judge can then put the names in each subgroup in rank order by laying the cards out on a table. This procedure will place the lowest of the "good" group near the highest of the "average" group and the lowest of the "average" group near the highest of the "poor" group. Thus it permits some rearrangement between subgroups in getting the final order.

Absolute rating scales. In absolute rating scales the judge assigns a score to each individual on each trait being rated. He compares each

one to some standard established independently of the particular group of individuals being considered. For example, he may rate each candidate on a seven-point scale of neatness or may check all the adjectives in a list that apply to the candidate. Though this method is quicker than that of relative rating, it is more subject to errors arising from the "personal equation" of the judges. That is, some judges assign too many high scores; others give too many low or average scores. Furthermore, the standards of an individual judge may fluctuate throughout the series.

Both types of rating scale are subject, but to a lesser extent, to the errors of judgment discussed in connection with the interview: halo and stereotypes. The influence of the halo effect can be minimized by having the judge rate all the individuals on only one trait at a time, so that his earlier ratings of a given person will be less likely to influence his later ones. Since rating scales provide numerical scores which can be analyzed objectively and related to other measurements, their results are far less ambiguous than are those of interviews.

Because the rating scale does depend so much upon the subjective judgments of the raters, however, it is usually regarded as inferior to the psychological test. Certainly the value of the ratings will depend both on a judge's ability to evaluate others and on his definition of the traits being appraised. To some extent these factors can be appraised by a check on how well two sets of judges agree on their ratings of the same individuals and on how closely the same set of judges agree on their ratings of the same individuals on successive occasions. Recent studies have indicated that with a skillfully constructed scale both of these potential sources of difficulty can be minimized.

A special type of absolute rating scale, the *forced-choice* rating scale, has been developed to offset the frequent tendency to rate nearly all persons near the top of the scale—the "leniency error." The basic principle is to require the rater to choose between two equally favorable descriptive statements.

The favorableness of each trait included is determined beforehand and they are presented in pairs. Although the statements in each pair are equally favorable, only one of them is a val-

id indicator of the dimension being measured. In many forced-choice scales each item contains four statements, consisting of two favorable and two unfavorable trait descriptions, of which one favorable and one unfavorable trait are valid. The rater is asked to choose the quality in each group of four statements which best describes the person being rated and the one which describes him least. An example of an item for assessing an individual's self-confidence and dependability might be:

- (0) emotional
- (-1) undependable
- (+1) self-confident
- (0) sociable

Here a point would be subtracted if the rater checked "undependable" as most descriptive of the applicant and a point would be added if he checked "self-confident." "Emotional" and "sociable" are invalid items. Checks opposite them would not count anything. The weights of the items, of course, are not revealed to the rater.

In actual practice the forced-choice method has not reduced leniency in rating as much as was hoped. Perhaps raters can sense which traits are valid, as well as which ones are favorable. Furthermore, most raters do not like to use forced-choice scales.

Behavior Sampling

In behavior sampling techniques, the examiner actually observes the person's behavior in a typical situation. Unaware that he is being watched, the subject will behave as he normally does.

The following test of honesty is an example of behavior sampling. A teacher asks his students to perform a task "on their honor" and then leaves the room, giving them ample opportunity to cheat. A few days later the same task is assigned, but this time the teacher maintains close supervision. A student who does well without supervision but performs poorly under supervision is likely to have cheated the first time. This procedure may be repeated with a variety of tasks on different occasions so that the investigator can get a reliable total score in

terms of the number of times the student cheated. The purpose of such tests is not to trap the students (nothing is ever said or done to the probable cheaters) but to obtain a measure of honesty in a specified situation.

A behavior sampling technique developed for the purpose of assessing leadership ability is the leaderless group discussion. Although procedures have not been highly standardized, they do share certain characteristics. A small group, about four to twelve persons, is assembled and given a problem to discuss. As the name implies, there is no leader. Typically, the participants are strangers, thus having no predetermined relationships to one another. The situation is left as unstructured as possible. The problem is not well defined—the definition is left largely to the group. No formal rules are established. Present, but not active in the discussion, are one or more observers. The observers rank or rate the participants on the amount of successful leadership displayed in the discussion (Bass, 1954).

Another interesting behavior sampling technique for assessing leadership qualities was developed by the Office of Strategic Services during World War II. Situations were set up which were as nearly as possible like those that a candidate might actually meet. For example, a construction test involved an assignment in which the candidate was to complete a piece of construction, supervising men who had secretly been instructed to make every attempt to sabotage the effort. Observers rated the candidate on his behavior under this type of stress (Fortune, 1946).

Later assessment of such tests proved them to be more expensive by far and less valid per hour of testing time than were objective psychological tests (MacKinnon, 1958).

A recent study has shown that behavior sampling techniques may have value as a supplement to more conventional testing procedures. Three situational tests—a simulated police patrol, a simulated missing person investigation, and a two-hour "bull session"—were found to predict success in Cincinnati, Ohio, Police Academy basic training (Mills, McDevitt, and Tonkin, 1966). ♦ Whether such tests will prove effective in predicting success of police officers over the years remains to be seen.

Self-Inventories

Standardized self-inventories require the subject to give information about *himself*. He may be asked to tell what he likes or dislikes to do, what emotional reactions he tends to have in certain situations, whether he admires or condemns various figures in public life, and so on.

The self-inventory blank is valuable in that it goes below the surface appearance to tap the individual's own personal experience and feelings. It is also convenient to give because it does not require the services of a group of raters



♦ In the second part of the Cincinnati police recruitment test, the candidate investigates the mysterious disappearance of a hypothetical city employee who supposedly worked at the desk shown here. Clues include race-track sheets, a Scotch bottle, tranquilizers, dunning letters from local stores, perfumed love letters, a passport application, and a memo from the City Manager requiring an audit of accounts. The candidate examines the clues for ten minutes, taking whatever notes he wishes, and then is asked to answer a questionnaire calling for factual data, hypotheses about the man's whereabouts, motives for leaving, and probable mental state, and ideas as to possible bases for prosecution.

or interviewers. Its chief disadvantage is that the person tested does not altogether understand himself and therefore cannot always give an accurate report. Or, if he wishes, he can easily lie about himself in an attempt to make the results look more favorable.

"Lie-detector" scales have been developed which make it possible to correct for such faking in scoring self-inventories. Interestingly enough, however, there appear to be cases in which the candidates' actual scores, faked or not, are more indicative of success or failure than are scores corrected for faking. When a group of experienced salesmen were given a self-inventory, it was found that their uncorrected scores differentiated more clearly between the good salesmen and the poor ones than did the corrected scores (Ruch and Ruch, 1965). The investigators hypothesize that the man who fakes a test in order to "sell" himself and his ability as a salesman has a better image of the job requirements and will in fact make a better salesman than the man who does not make every effort to "put his best foot forward."

The self-inventory method, carelessly used, has often been disappointing as an instrument for selecting personnel in business and industry. In careful hands, however, it works well as a device to aid in evaluating applicants for employment or candidates for promotion (Guion and Gottier, 1965). It has also been valuable in clinical guidance situations, where the individual usually wants to gain greater understanding of himself and therefore answers questions about himself as honestly as he can.

The early interest and personality inventories were developed for the purpose of classifying individuals in terms of either occupational interest or psychopathology. Many such measuring devices are developed by the process of *item analysis*. Psychologists determine which of a number of items are answered in a consistent way by most members of a particular group. On the basis of this information, a scoring system is worked out. One of the better known item-analyzed self-inventories is the Strong Vocational Interest Blank, which was developed by administering a large number of items on interests to people successfully engaged in various occupations. The basic principle was that a person who marked a great majority of the

items in the same way as successful doctors did, for example, would be likely to be successful and happy as a doctor (Strong, 1951).

In actual practice this test has proved to be of considerable value in predicting vocational success among men. It does not work as well with women, partly because all career women tend to resemble each other and to differ from women in general.

Some self-inventories are made up of items selected on the basis of expert opinion. A widely used test of occupational interests, the Kuder Preference Record—Vocational, belongs in this category. In contrast to the Strong Vocational Interest Blank, its major purpose is to indicate relative interest in a few broad areas, rather than in particular occupations. Items were tentatively grouped on the basis of expert opinion and extensive analyses were conducted in high-school and adult groups, in order to develop item groups showing high reliability and low correlations with other groups.

The Kuder items are of the forced-choice triad type. For each group of three items, the respondent indicates which he would like most and which he would like least:

EXAMPLE

Put your answers to these questions in column O.

P. Visit an art gallery	
Q. Browse in a library	
R. Visit a museum	most →
S. Collect autographs	most →
T. Collect coins	
U. Collect butterflies	

O
P
Q
R
S
T
U

← least

This test is scored on the following nine scales: Mechanical, Computational, Scientific, Persuasive, Artistic, Literary, Musical, Social Service, and Clerical:

1. Mechanical: Indicates a preference for working with machines and tools.
2. Computational: Indicates a preference for working with numbers.
3. Scientific: Indicates a preference for discovering new facts and solving problems.
4. Persuasive: Indicates a preference for meeting and dealing with people, and promoting projects for things to sell.
5. Artistic: Indicates a preference for doing creative work with one's hands. It is usually work that has "eye appeal" involving attractive design, color, and materials.

6. Literary: Indicates a preference for reading and writing.
7. Musical: Indicates a preference for going to concerts, playing instruments, singing, or reading about music and musicians.
8. Social Service: Indicates a preference for helping people.
9. Clerical: Indicates a preference for office work that requires precision and accuracy (Kuder, 1960).

The respondent's score indicates the areas in which his major interests lie. He can then narrow his field of investigation to those occupations that are consistent with these fields of interest. Experienced counseling based on the test results may call his attention to an occupational area he had not previously considered because he was unfamiliar with its potential suitability.

TRADITIONAL MEANS OF TESTING INTELLIGENCE

The most elaborate refining of *aptitude tests* has been done in connection with the measurement of intelligence.

Teachers have long recognized that individuals differ in level of intelligence, but it was not until the early part of this century that a method of measuring intelligence was developed. This method was valuable in its time and is still in wide use, although factor analysis is now giving us more precise and economical methods of measuring intelligence as well as other abilities.

Binet's Early Scale

In 1904, the Minister of Public Instruction in France formed a commission of medical men, educators, scientists, and public officials to study the problem of how to teach the feeble-minded children in their public schools. The important work of this commission was done by Alfred Binet, a scholar of the then young science of psychology, and Theodore Simon, a physician. These men believed that before a program of instruction could be planned it was necessary to work out some way of measuring the intelligence of the children they were studying.

Binet and Simon prepared a test of intelligence containing problem situations which could be scored objectively, were varied in nature, were little influenced by differences in en-

vironment, and called for judgment and reasoning rather than mere rote memory.

Binet expressed the results of his tests on feeble-minded children in terms of the age at which normal children could make the equivalent score. This was called the *mental age* (MA) of the child. When a child's score on the test was equal to the arithmetic mean of the scores of five-year-olds, he was said to have an MA of five, regardless of his actual (chronological) age.

Binet's extensive use of intelligence tests showed conclusively that intelligence exists in degrees, following a normal distribution. Most people's scores cluster around the average, and there is no break between the dull, the average, and the bright.

You can get a good idea of what the Binet scale was like from these examples of capabilities expected of a normal person at different ages. (Binet and Simon, 1911).

- | | |
|--------|--|
| Age 3 | Can point to nose, eyes, and mouth on request. |
| Age 5 | Can count four coins. |
| Age 7 | Can show right hand and left ear. |
| Age 9 | Can define familiar word in terms superior to use; i.e., shows how it is related to other ideas. |
| Age 12 | Uses three given words in one sentence. |
| Adult | Gives three differences between a president and a king. |

As more and more children were tested and retested at later dates, it was found that a retarded child usually fell further and further behind as he grew older. If a four-year-old child had a mental age of three, for example, his mental age at eight probably would be only six. Thus, although the mental and chronological ages maintained the same relationship to each other ($\frac{3}{4} = \frac{6}{8}$), the total retardation would have increased from one year to two years.

Early in the history of intelligence tests, therefore, psychologists adopted the practice of stating the relationship between mental age (MA) and chronological age (CA) as a ratio (Stern, 1914). This ratio is known as the *intelligence quotient* (IQ) and is computed as follows:

$$IQ = \frac{MA}{CA} \times 100$$

The purpose of multiplying by 100 is merely to eliminate decimals. Thus, if an individual's MA and CA are the same (that is, he is of average intelligence), his IQ is 100. If his MA is 10 and his CA is only 8, his IQ will be 125. This ratio gives a figure for any given individual that remains *more or less* constant over a period of years. Thus it is possible to compare individuals of differing ages or the same individual at different ages.

The Stanford Revisions

The concept of IQ was used in the development of intelligence tests by L. M. Terman of Stanford University, who tested almost 3000 children with Binet's materials and other tests. He arranged the tests by mental age levels and in 1916 published the Stanford Revision of the Binet Tests, which remained for twenty years a standard instrument in clinical psychology, psychiatry, and educational counseling.

In the course of those twenty years, however, the 1916 scale proved to have certain defects and limitations. For one thing, it was not applicable to adults. The ratio of MA to CA is fairly constant up to a CA of about thirteen, but from then on mental age increases more slowly. Although the mental age of a ten-year-

old is twice that of the same child at age five, the mental age of a forty-year-old is *not* twice that of the same person at age twenty—it is about the same. This means that if the IQ were computed in the usual manner, it would decline from about age thirteen on. Therefore, the CA must be “corrected” for adults if the IQ is to remain constant.

In 1937 Terman and Maud A. Merrill published a revised edition of the Stanford-Binet (Terman and Merrill, 1937). This new revision was aimed at correcting the difficulties and defects of the former scale as follows:

1. The test was extended at the upper limits of the intelligence scale so that differentiations could be made among adults of superior intelligence. A table for finding IQ's was constructed which included a “correction” in the CA of adults.

2. Provision was made for testing children as young as two years of age. Sets of tests were provided at half-yearly intervals for children from two to five, a period when mental growth is very rapid, and at yearly intervals thereafter.

3. The 1937 scale contained two forms of comparable materials so that when retesting was necessary the psychologist would not need to be concerned about a practice effect.

As time passes, even the most carefully constructed test becomes obsolete and needs revision. This is especially true in the case of verbal tests, since meanings of words change, and formerly rare words suddenly spring into popularity. The vocabulary of the present-day child or adult, oriented to space and television, is much different from that of the persons who were tested when intelligence tests were first used. For example, *Mars* was a very difficult word for children in the 1916 edition of the Stanford-Binet, being equal in difficulty to the word *conscientious* at that time (Terman, 1916). In the 1937 edition it was much more familiar (thanks to Buck Rogers), being no more difficult than the word *skill* (Terman and Merrill, 1937). By the late 1950's, when space travel was an everyday topic of conversation, this planet name had become about as familiar as the everyday word *eyelash* (Terman and Merrill, 1960).

Another reason for periodic revision is that continued use of a test often reveals weaknesses

which were not apparent at first. In the case of the 1937 Stanford-Binet, it was found that the spread of IQ's obtained was different at different age levels. The standard deviation of the IQ's of six-year-olds was 12.5, whereas the standard deviation of IQ's of twelve-year-olds was 20. That meant that a six-year-old with an IQ of 110 was .8 standard deviations above the mean, superior to 79 per cent of his age group; whereas a twelve-year-old with the same IQ was only .5 standard deviations above the mean, superior to 59 per cent of his age group. In other words, the 1937 Stanford-Binet was *not* comparable from one age group to another, in spite of the careful steps taken to make it so.

For these reasons the Stanford-Binet was again revised in 1960. Although the 1960 edition contains most of the items which were in the 1937 edition, the scoring procedure has been changed. Fairly complicated statistical procedures have been used to ensure that the standard deviations of IQ's at all age levels are equal to 16. Unfortunately, the 1960 edition has only one form. An alternate item is provided at each level, however, to be used when there is an error in the administration procedure.

Performance Tests

Even the 1960 revision of the Stanford-Binet, although it measures other abilities to some degree, is predominantly a test based on the use of words or ability to think and communicate through the use of words. Thus for a deaf child or for a child who does not come from an English-speaking home, the Stanford-Binet often does not give a fair score.

It has been necessary, therefore, to develop certain tests called *performance tests* in which hand reactions are substituted for verbal reactions. Sometimes even the instructions are given without the use of speech. Performance tests include such tasks as *form boards*—boards with recesses into which the individual must fit blocks of the proper size and shape as quickly as he can—and *picture completion tests*, in which the individual looks at an incomplete picture and decides which of several parts will fit most sensibly into the blanks. Some examples of per-

formance tests are shown on page 160. It is possible to derive children's mental ages from the scores obtained on such tests.

The WAIS and the WISC

The Wechsler Adult Intelligence Scale (Wechsler, 1955) and the Wechsler Intelligence Scale for Children (Wechsler, 1949) are combinations of both verbal and performance tests. The WAIS and the WISC, as these scales are referred to for the sake of convenience, are similar in content, differing chiefly in difficulty. The WISC has been standardized for children of ages two through fifteen years. The WAIS is for age sixteen and over. Both tests consist of two parts—verbal and performance. The verbal section includes tests of general information, comprehension, vocabulary, similarities between words, arithmetic, and digit span (repeating a series of digits after the examiner).

The performance section also has several parts. In the block design test the subject tries to reproduce a series of designs shown on cards by fitting together colored blocks whose six sides are all different. In the picture arrangement test the task is to arrange a series of pictures in the correct sequence so that a meaningful story is depicted. Some of the other performance tests include mazes (in the WISC only), picture completion, and object assembly.

An important feature of these tests is that instead of deriving the IQ in the traditional manner, the psychologist computes the subject's intelligence rating by comparing his test performance with the scores earned by others of his own age group only. If he is at the mean, his IQ is set at 100. If he is one standard deviation above the mean, it is set at 115. If he is one standard deviation below the mean, his IQ is 85. The IQ's of individuals in the same age group form a normal distribution, with a mean of 100 and a standard deviation of 15. The distribution of Wechsler IQ's and Stanford-Binet IQ's is shown in the diagram on page 142.

The Meaning of IQ in Terms of Behavior

What is a person like who has an IQ of 100? What can he do that someone with an IQ of 70

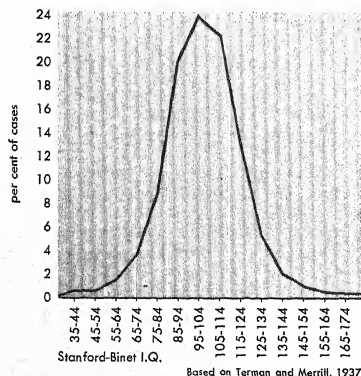
cannot? Trained psychologists, as well as teachers and physicians dealing with problem cases, associate different IQ values with definite pictures of adaptive behavior.

Classification of IQ's. Several classifications of IQ have been suggested by different test makers, usually in terms of categories containing a given number of IQ points. An easily understood classification can also be made in terms of standard deviations. This is illustrated by the graph, which shows the curve obtained for the children on whom the 1937 Stanford-Binet intelligence scale was standardized.

The great majority of people—68.2 per cent—are within one standard deviation of the mean IQ, which is 100. Their IQ's would fall between 84 and 116 on the Stanford-Binet, and they may be regarded as being of average intelligence. Those in the next standard deviation on the lower end of the distribution (about 13.6

per cent) are dull normal or borderline; those in the second standard deviation at the upper end (another 13.6 per cent) are of superior intelligence. The third standard deviation at the lower end accounts for about 2 per cent of the population and persons within this range and beyond are generally classified as mentally retarded, or feeble-minded. The corresponding segment at the upper end, with an IQ above about 135, is the group often identified in the schools as "gifted." Where possible, children in this group are given an accelerated or enriched program commensurate with their greater potentiality for learning.

In general, it can be said that the higher the economic standing of an occupational group the higher the average IQ. Within every group, however, there is a considerable range in IQ. At the top, the range is narrower, because only persons of high IQ can enter such occupations as law or accounting. In occupations like auto repairing or clerking, however, persons of low, average, and high IQ may be found. The illustration shows the average IQ of several occupations and also the range of one standard deviation above and below the mean, within which roughly two-thirds of that occupational group fall. ¹⁵



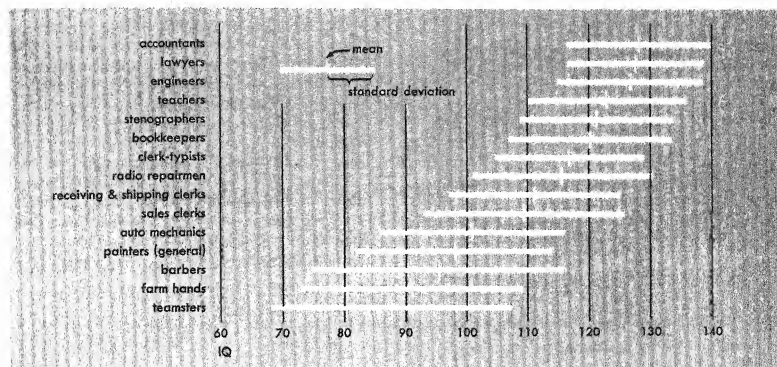
◆ THE DISTRIBUTION OF IQ'S

This classic curve, obtained from the scores of the standardization group on the 1937 Stanford-Binet, gave striking confirmation of the hypothesis that traits are distributed in the population at large in accordance with the "normal" curve.

The mentally gifted. Until recently the mentally gifted have not received the attention and stimulation they deserve in our mass education system. As Sidney L. Pressey has pointed out (1955), children who have precocious ability in music or athletic skills are usually encouraged and given every opportunity to practice and improve; whereas intellectual precocity is too often regarded as "somehow not quite healthy," and the gifted child, if not actually ridiculed, is rarely helped or even permitted to progress as rapidly as he could. Fortunately, with today's emphasis on science and the "space race," the current trend is in favor of broader opportunities for the gifted through various acceleration programs. The old grade-skipping method, unsatisfactory at best, is being replaced by such systems as the "ungraded primary pool," in which children spend only as much time as they need to and out of which they move whenever they finish primary work. Rapid-progress sections in junior and senior high school (en-

INTELLIGENCE AND OCCUPATION

This graph, based on scores from the Army General Classification Test, shows the intelligence levels of fifteen occupations. Perhaps the most striking thing about these figures is the degree of overlapping, showing the wide range of occupations possible for persons of a given IQ.



Based on Horrell and Horrell, 1945

abling especially bright students to do three years' work in two) and credit by examination in college are other devices for permitting mentally gifted youngsters to move at their own pace without feeling that they are unduly conspicuous.

What becomes of gifted children in later life? One group of investigators has been following the fortunes of 1300 individuals identified as gifted children in 1922.

These children represented the cream of the crop of some 250,000 California school children tested that year. All had an IQ of 140 or more; the mean IQ for the group was 150. In 1940, and again in 1955 and 1959, surveys were conducted to see how well these individuals had succeeded in life. The results leave little doubt that the intelligence test measures something vitally important to successful living. Here are the facts:

1. The insanity and suicide rates were lower than those of the general population. This fails to support the

legend that "genius is akin to insanity."

2. The divorce rate of the gifted group was lower than that for the state of California as a whole.

3. Ninety per cent of the gifted group entered college; of these, about 93 per cent graduated. This showing is considerably higher than the standard for the country as a whole. They received higher college grades and more honors than did average college students. The gifted were also far more active in student-body affairs, as shown by election to office and activity point scores.

4. The earnings of the gifted group far exceeded those of the general public of the same age. Not one of the group was on the relief rolls during the depression, even though many had finished their schooling and were just starting in life when the depression hit. At age 30, their average earned income was twice the national average at that time.

5. Measured in terms of creativity, as well as earnings, the achievement of these gifted individuals was striking. (The following figures include only the men, since most of the women married and did not follow professional

careers.) By 1950, when the 800 men included in the study had reached an average age of 40 years, they had published 67 books, more than 1400 technical or professional articles, over 200 short stories and plays, and 236 miscellaneous articles, not counting innumerable publications by those who were journalists or radio and TV script writers. Of the 800 men, 78 had taken Ph.D. or equivalent degrees, 48 had medical degrees, 85 had law degrees, 74 had taught at the college level, and 104 were engineers. Nearly all these figures are from ten to thirty times as large as would be found for 800 men of the same age chosen at random.

6. A special Concept Mastery Test, designed to "reach into the stratosphere of adult intelligence," was administered to 950 of the group in 1939-1940 and to more than 1000 in 1951-1952. On both tests they scored as far above the average adult as they had scored above the average child when originally tested. Also in the twelve-year interval between the two adult tests, 90 per cent of

those who took both tests had increased their intellectual stature, as shown by higher scores on the second test. This disproves the "early ripe, early rot" idea that people who are brilliant in their youth deteriorate early (Terman, 1925, 1940, 1954, 1959).

The investigators also studied the offspring of the gifted group and found that the average IQ of the 300 offspring tested was 127—considerably lower than the original group's average of 150. At least two factors help to explain this. First, the gifted parents had married husbands or wives who were, for the most part, of somewhat lower IQ than themselves although still above the national average. Second, as we saw in Chapter 3, heredity operates, through such factors as reduction division and recessive genes, to produce not merely similarities but also differences between parents and their chil-

LEVELS OF MENTAL RETARDATION

Level of Retardation	Preschool Age (0-5) Maturation and Development	School Age (6-21) Training and Education	Adult (21+) Social and Vocational Adequacy
Mildly retarded (IQ 50-70)	Can develop social and communication skills; minimal retardation in sensory-motor areas; rarely distinguished from normal until later age.	Can learn academic skills to approximately 6th grade level by late teens. Cannot learn general high-school subjects. Needs special education particularly at secondary school age levels. ("Educable")	Capable of social and vocational adequacy with proper education and training. Frequently needs supervision and guidance under serious social or economic stress.
Moderately retarded (IQ 35-50)	Can talk or learn to communicate; poor social awareness; fair motor development; may profit from self-help training; can be managed with moderate supervision	Can learn functional academic skills to approximately 4th grade level by late teens if given special education. ("Educable")	Capable of self-maintenance in unskilled or semiskilled occupations; needs supervision and guidance when under mild social or economic stress.
Severely retarded (IQ 20-35)	Poor motor development; speech minimal; generally unable to profit from training in self-help; little or no communication skills.	Can talk or learn to communicate; can be trained in elementary health habits; cannot learn functional academic skills; profits from systematic habit training. ("Trainable")	Can contribute partially to self-support under complete supervision; can develop self-protection skills to a minimal useful level in controlled environment.
Profoundly retarded (IQ below 20)	Gross retardation; minimal capacity for functioning in sensory-motor areas; needs nursing care.	Some motor development present; cannot profit from training in self-help; needs total care.	Some motor and speech development; totally incapable of self-maintenance; needs complete care and supervision.

Based on Sloan and Birch, 1955. Used by permission of the American Journal of Mental Deficiency.

dren. If the parents are near the top of the distribution, as in this case, these differences are most likely to be in the downward direction.

Figures based on the experience of the American Telephone and Telegraph Company involving thousands of cases show clearly that excellence in scholarship, as measured by rank in the student's graduating class, is predictive of attaining a high-level job.

Of men who had been in the top third of their class, 45 per cent were in the top third in salary, when all college graduates were considered. Among graduates of top-ranking colleges, the corresponding figure was 55 per cent. Leadership in extracurricular activities had some predictive value, but the relationship was moderate as compared to excellence in scholarship. Mere participation in extracurricular activities had no predictive value (American Telephone & Telegraph Personnel Research Section, 1965).

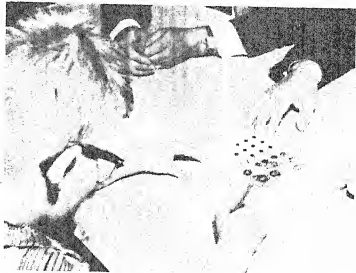
Obviously, the belief existing among some college students that business is looking for "C" students rather than Phi Beta Kappa members is false. The student who lacks time for both scholarship and activities should put scholarship first if he wishes to attract the attention of a modern and efficient employer.

Mental retardation. There are over 200,000 human beings in institutions for the mentally retarded in the United States (Kennedy, 1963). These are less than one twentieth of the total number of mental retardates. The rest are living in their real or foster homes.

Current descriptive terminology makes use of a fourfold classification of the mentally retarded based on measured general intelligence and the quality of observed adaptive behavior. This includes the *mildly retarded* (IQ range from 50 to 70), the *moderately retarded* (35 to 50), the *severely retarded* (20 to 35), and the *profoundly retarded* (below 20). The levels of adaptive behavior which individuals within each classification are capable of reaching are shown in the chart.

Classifications of this nature are of necessity arbitrary, since intelligence, as we have seen, exists as a continuous function. The present terminology replaces the earlier designations of

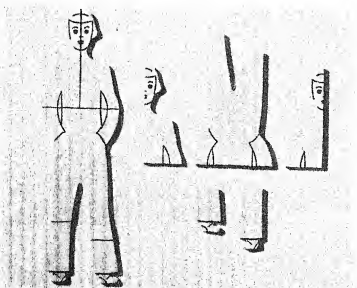
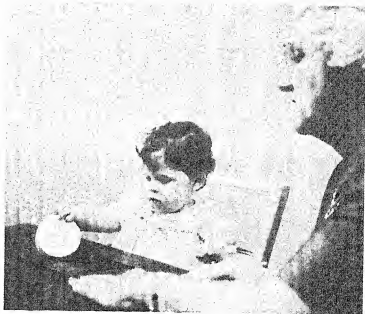
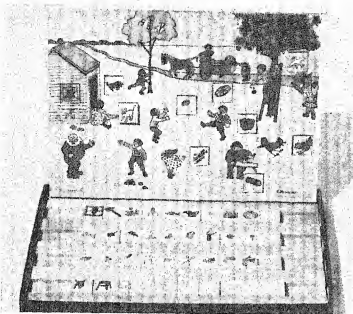
This mentally retarded boy has been asked to copy the pattern of dots and the sentence "Fred is here." His performance in these and other standardized tasks will indicate both the extent and the pattern of his retardation.



moron (50 to 70), *imbecile* (25 to 50), and *idiot* (below 25) which have come to be so widely misused in everyday speech.

In the final analysis, the definition of mental retardation is a social one and, in many states, a legal one. The term is applied to those persons who because of low intelligence are not capable of conducting their affairs without supervision.

There are about 5,000,000 mildly retarded persons in the United States. Adults in this category can learn to read, write, and perform routine factory work, although they usually do not go beyond the fifth or sixth grade in school. If left to themselves, they often run afoul of the law, for many are incapable of recognizing their moral and legal obligations or of foreseeing the consequences of their behavior. The fact that they mature physically as early as normal persons and are physically indistinguishable from normal persons but lack the capacity to control their natural impulses makes their problem as adults an especially difficult one. The frequency of illegitimate motherhood, for example, is high among girls who are mildly retarded. Many mildly retarded persons become juvenile delinquents, prostitutes, toughs, and petty thieves—though, of course, low intelligence is only one of many factors in delinquency. Furthermore, the behavior of persons of low



These performance tests are included in several intelligence scales. The Healy Picture Completion Test (upper left) presents scenes with square recesses into which the child is to put the most appropriate piece he can find from a large group of pieces all the same size and shape. In the Kohs Block Design Test (center left), the subject tries to copy a series of patterns of increasing complexity using cubes with a different color or pattern on each face. The Manikin Test (lower left) requires the subject to assemble five pieces into a complete figure. Form boards (above) are favorite performance tests because they are easy to standardize and score, do not draw specifically on previous experience, usually enlist good motivation and effort in subjects of all ages, and give results that correlate well with other measures of intellectual functioning.

intelligence does not follow a set, stereotyped pattern but depends largely upon the complexity and demands of their environment and the kind of training they receive. Even among those who obtain an IQ as low as 60 in childhood, some can be expected to become self-supporting citizens if they receive adequate training (Charles, 1953).

Does the IQ Remain Constant?

The whole concept of the IQ presupposes that an individual will maintain the same relative position in his group as he grows older. A great many studies have been carried out to determine whether or not this actually is the case. The universal conclusion is that the IQ does remain essentially constant when conditions remain the same—that is, when health, type of education, and home situation do not change markedly. The single notable exception is in the case of very young children, whose potentialities may still be more variable, and with whom, in any case, there are special testing difficulties.

Of the many studies on constancy that have been made on individuals ranging from the feeble-minded to the very superior, the following is typical.

A study was made of 1106 children who were referred to a Child Study Department because of unsatisfactory school adjustment—behavior problems as well as poor achievement. The children were tested at the beginning of the study and then retested one or more times at intervals ranging from six months to ten years. They varied in age from about six and a half to twelve and a half years at the time of the first testing. The average amount of IQ change found in retesting was 5.08 IQ points. There was a tendency for the lower IQ's to decline slightly despite the fact that approximately half of the children were placed in special classes where their difficulties received special attention from well trained teachers. Nevertheless, this study indicated that the IQ remains relatively constant (Hirt, 1945).

Although there are a few cases on record of a change of 50 or more IQ points, most studies comparing IQ's obtained after the preschool years have found an average fluctuation of about five points.

PRIMARY MENTAL ABILITIES

Although there obviously are many situations in which it is helpful to know the general overall level of a person's intelligence, as indicated by an IQ rating, modern research has shown that the "general intelligence" represented in an IQ figure is actually a composite of a number of "special intelligences" or *primary abilities* which are relatively independent of each other. Two people who obtain the same IQ may have a very different pattern of specific abilities and deficiencies: one may do best on the verbal and abstract reasoning questions, the other on the memory and motor skill items. These differences are masked behind the single composite score. The questions of the Stanford-

Binet, for example, sample a variety of these special abilities at each age level. This is not done in a systematic way, however, and no separate scores are obtained for the different types of items. The WAIS and WISC give separate verbal and performance scores, but make no further differentiation within these two general categories.

Factor Analysis

In the last thirty-five years great strides have been taken in the isolation and identification of primary mental abilities by means of factor

analysis. This is an analysis of the intercorrelations among tests; it is based on the assumption that a positive correlation between two tests means they are measuring the same ability or abilities and that, by the same token, a zero correlation means that the tests, if they are reliable, are measuring different abilities.

The work of Spearman. As early as 1904, Charles Spearman proposed a two-factor theory of intelligence (Spearman, 1904). Spearman had found that most of the mental tests then available correlated positively but that the correlations were not as high as their reliability would have made possible if they were all measuring the same thing. He concluded that each test must be measuring two factors—a *general* factor, which he called *general intelligence*, and a *specific* factor, unique to each test.

More refined statistical techniques have shown that the picture is considerably more complicated than this. It is now recognized that in most cases where tests correlate positively with each other, they share not one general factor but several factors, each contributing its share to the correlation. The more factors two tests have in common, the higher their correlation. Thus psychologists today generally accept a *multiple factor theory*.

The work of Thurstone. The real pioneering work in the investigation of primary factors in intelligence was done in the 1930's by L. L. and Thelma Thurstone (Thurstone and Thurstone, 1941). In one of his experiments, Thurstone administered to high-school and college students a battery of fifty-seven tests designed to measure general intelligence. Using factor analysis, Thurstone was able to determine the extent to which various tests measured the same factor or ability. From this and subsequent experiments, he identified seven separate factors of intelligence: verbal comprehension, numerical ability, perceptual speed, space visualization, reasoning, word fluency, and memory. He then developed seven separate tests, each aimed at measuring one, and only one, of the seven factors (Thurstone and Thurstone, 1947).

Verbal comprehension is a measure of ability to use words in communication, thinking, and planning. It is highly indicative of reading

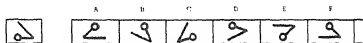
speed and ability to understand written or spoken instructions, and is the most important aspect of "general intelligence." It is measured by items of increasing difficulty, like the following, in which the individual is to tell which of the four words on the right is like the one on the left.

BIG A. ill B. large C. down D. sour

Numerical ability measures the ability to work easily with numbers, to do simple arithmetic fast and accurately.

Perceptual speed measures ability to see small details quickly and accurately. High perceptual speed is a very important ability in areas involving detailed "paper work."

Space visualization is a measure of ability to visualize space and form, to remember form and manipulate it mentally. People who are high in this ability are usually adept at such things as drafting, blueprint reading, and mechanical work, while people who are low in these abilities are likely to have difficulty learning in these areas. This ability is measured by items like the following in which the subject indicates which figures on the right can be rotated to be exactly like the one on the left.



Reasoning measures ability to see relationships in situations described in symbols. This is an extremely important ability since most of our thinking is done in terms of symbols. This test measures the kind of thinking that is done in a great many practical situations. An important feature of this test is that it measures ability to decide whether or not sufficient information is given to support a logical conclusion—a feature which is characteristic of administrative and technical decision making.

Word fluency is a measure of the individual's ability to express himself in words, to "find the word he wants when he wants it." People who are high in this ability tend to talk well and to write easily and quickly, if they have other necessary expressive skills. Those who are low in this ability tend to "grope for words" and to

have difficulty in expressing themselves in speech and writing, especially in stress situations.

Memory is a measure of the individual's ability to recall and associate previously learned items.

If Thurstone had succeeded in breaking intelligence down into seven unique components, scores from these tests would have shown no correlation with each other at all. But when he administered the tests to a new group of students and computed the correlation coefficients between each test and every other test he found that the tests were correlated. This could mean that in addition to the special factors there was a general intelligence factor, as Spearman had postulated, that could not be subdivided. Or it could simply mean that he had not succeeded in devising "pure" enough tests. The fact that Thurstone did not succeed in developing uncorrelated tests cannot be taken as proof that it cannot be done. Whether or not there is such a thing as general intelligence, in addition to the primary abilities, is still in dispute today (McNemar, 1964). Perhaps Thurstone's failure to analyze intelligence entirely into unique components was due to the fact that there are actually many more separate factors than Thurstone found.

Guilford's Structure of Intellect

A series of studies is presently being conducted which classifies all intellectual abilities into a systematic framework called the *structure of intellect* (Guilford, 1961). According to this model, human intelligence can ultimately be broken down into 120 factors. Not all of these have been discovered as yet.

Guilford classifies intellectual factors in three different ways: according to content, according to product, and according to operation. *Content* refers to the kind of information involved. Four different types of content have been identified.

The first type of content is *figural*; that is, it involves concrete objects. *Symbolic* content is concerned with information represented by means of symbols, as in mathematics. The third type of content, *semantic*, involves mean-

ings. This category includes such factors as verbal comprehension and general reasoning. A fourth kind of information is *behavioral* content. This is the area which Thorndike (1927) has called "social intelligence"—the ability to deal with people.

There are six different forms which each type of content may take; these are referred to as *products*. A single item of information is a *unit*; a group of units with common properties form a *class*. Information may also come in the form of a *relation* between two things, or a more complex *system* involving a number of parts. Information involving some sort of change is called a *transformation*. The sixth type of product involves the possibilities offered by a piece of information—its *implication*.

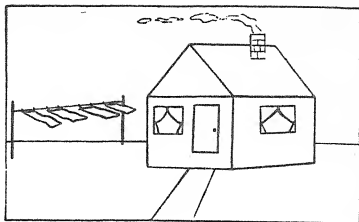
There are five types of *operation* that can be performed on a particular bit of information. The first of these is *cognition*; that is, understanding or comprehension. Another type of operation is *memory*. There are two types of operation that involve the production of new information. The first of these, *convergent production*, is the ability to derive the one correct answer to a problem from the information provided, as in mathematics. *Divergent production*, on the other hand, involves the devising of a number of possible solutions to the problem posed by a particular set of information. This is believed to be an important factor in creative thinking (Guilford, 1960). The fifth type of operation that may be performed on any kind of information is *evaluation*, involving judgments as to accuracy, goodness, suitability, or workability.

These elements—content, product, operation—are represented in different combinations in separate intellectual abilities. That is, any type of content may take the form of any of the six products ($4 \times 6 = 24$). On these twenty-four resulting kinds of information, any of the five types of operation may be performed ($24 \times 5 = 120$). Thus we have a total of 120 possible intellectual abilities. These are illustrated in the structure of intellect model, a three-dimensional figure in which one of the three categories is represented along each dimension. Each of the 120 cells of this model represents one of the 120 ability factors and is represented by high scores on a particular

kind of test. ♦ For example, ability for *cognition* of systems using *symbolic* content can be tested by items like the following:

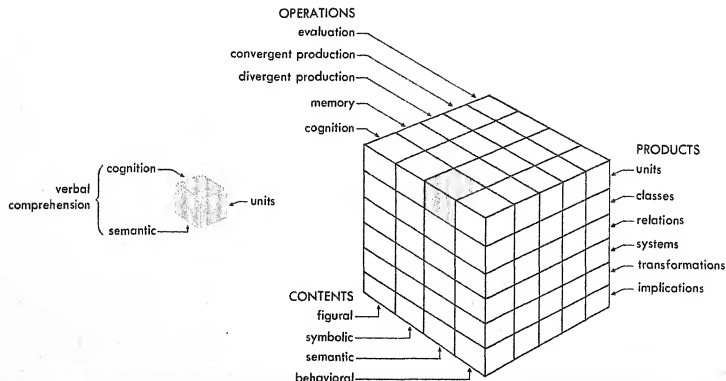
—
d —
b e —
a c f ?

One test of *divergent production* involving *relationships* with *symbolic* content is to give the subject four small digits and ask him how many ways he can relate them to produce a total of 8. A test of *divergent production* involving *systems* with *semantic* content is to give the subject the outline of a plan and ask him to give all the details he can think of to make the plan work. *Convergent production* of *systems* using *semantic* content might be tested by presenting in scrambled order several steps in the planting of a new lawn and asking the



individual to put them in the right order. *Evaluation*, involving judgments as to accuracy, goodness, or suitability, can be tested in relation to *systems* with *figural* content by items like the picture above.

This theoretical model is analogous to the chemist's periodic table of the elements. By means of such a systematic framework intel-



♦ THE STRUCTURE OF INTELLECT

Each factor can be classified as to operation, product, and content. There are 5 kinds of operations: *evaluation*, *convergent production*, *divergent production*, *memory*, and *cognition*; 6 kinds of products: *units*, *classes*, *relations*, *systems*, *transformations*, and *implications*; and 4 kinds of content: *figural*, *symbolic*, *semantic*, and *behavioral*. An example of one such factor is the well known verbal comprehension, which under this system is classified as cognition of semantic units.

tual factors, like chemical elements, may be postulated before they are discovered. In several cases this has in fact happened: abilities postulated on the basis of the model have later been successfully identified by testing (Guilford, 1964, 1966).

If intelligence is indeed as complex as Guilford's investigations suggest, it is obvious that a single test score cannot be considered a fair indication of an individual's "intelligence." Further study is needed to develop accurate methods of testing and scoring intellectual ability.

THE DETERMINANTS OF INTELLIGENCE

Why is it that some individuals are mentally defective, some are average, and some are geniuses? Since man is a product of his heredity and his environment, the answer must lie with one of these or with both. Many studies have been conducted in an effort to determine the relative importance of each of these variables.

The Relative Contributions of Heredity and Environment

One way to determine the relative contributions of heredity and environment is to hold one of them constant while the other varies.

Heredity constant, environment varying. The best way to study the role of constant hereditary factors in varying environments is to study identical twins who have been separated and reared in different foster homes. Knowing that identical twins have exactly the same heredity, we can assume that any differences in intelligence between the twins in a pair are attributable to environmental influences. While it is impossible to conduct an experiment of this nature deliberately, such separations do occur at times, and psychologists are able to take advantage of these "natural experiments."

An early study of this kind involved nineteen pairs of identical twins who happened to be reared apart through adoption into different foster homes. The average of the difference in intelligence level between the members of each of the nineteen pairs was found to be 8.2 IQ points. This difference is only slightly larger than the average

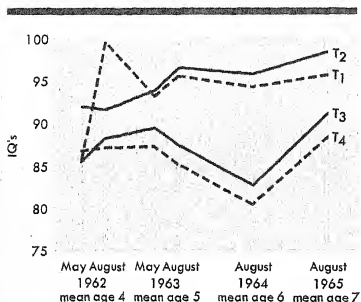
of the differences between the scores on two tests taken by the same individual at an interval of several years. That is, the intelligence test scores of identical twins reared apart (sometimes in similar and sometimes in quite different environments) were almost as similar as two scores achieved by the same person at different times. Furthermore, they were nearly as alike as those of identical twins reared together. The investigators concluded that possession of identical heredity was a factor operating systematically to determine the development of similar intelligence (Newman, Freeman, and Holzinger, 1937).

A more recent study was made of eighty-eight pairs of identical twins, of which half were reared together and half were brought up in different homes. The correlations between their intelligence test scores were .77 for those reared together and .76 for those reared apart. These figures give scant support to the popular notion that differences in environment play a major role in determining differences in intelligence (Shields, 1962).

Another method of separating the effects of environment and heredity is to observe what happens to the IQ of the same individual when he is placed in a different environment. Studies of this type have analyzed the IQ changes in children placed in foster homes and in children attending nursery schools. The graph on page 166 shows the results of one such study. As already noted, the typical finding is that IQ changes to some extent with changes in environment, especially at an early age, but that it retains considerable constancy even when the change in environment is great. Such constancy indicates strong hereditary influence.

THE EFFECTS OF EARLY TRAINING

This graph shows the results of a study undertaken to see whether, by special training, it is possible to offset the progressive retardation in mental development commonly seen among culturally deprived children. Starting at ages four and five, respectively, Groups T₁ and T₂ had ten-week summer sessions designed to foster achievement motivation and to increase perceptual and language skills. Groups T₃ and T₄ had only periodic tests. For both experimental groups, sharp gains during the special training and a much slower rate of development in succeeding months are reflected in corresponding changes in IQ. Meanwhile, the rise in MA of the control groups was so slow throughout that their relative retardation by age six was much greater than at the start of the study. First grade accelerated their rate of development, but they did not catch up with the other groups.



Based on Gray and Klaus, 1965; Gray, 1966

Studies such as those reported above are concerned with subjects growing up in homes that fall within the "normal" range of environments; they do not negate findings, discussed in Chapter 3, that an extremely impoverished environment will retard the rate of development.

Environment constant, heredity varying. If children are adopted into foster homes of high or low quality without regard to the quality of their heredity, the coefficient of correlation between the quality of the homes and the quality of the children's heredity will be zero. Therefore, if the correlation between intelligence and quality of the environment is positive after a

period of residence in the foster homes, we can interpret that increase as reflecting the effects of environment. Does this occur?

In one study, a group of children living with their own parents were compared with a group of children who had been adopted into foster homes before the age of six months and who were five to fourteen years of age at the time of the study. It was assumed there could be no relationship between the quality of the heredity of the foster parents and that of their adopted children. To make the two groups comparable, each child in the adopted group was paired with a child in the other group on the basis of the real or foster parents' intelligence test scores and on the basis of objectively measurable environmental factors, such as occupation and educational status.

In all cases the correlations between parent intelligence and child intelligence were positive, but the coefficients between the real parents and their children were much higher for all the traits studied than were those between foster parents and foster children. In other words, home environment all by itself had some influence on the level of intelligence of the children but not nearly as much as did home environment plus hereditary relationship (Leahy, 1935).

A fruitful way of studying twins which does not require separating them is to compare the performance of identical twins, who have the same heredity, with that of fraternal twins, whose heredity is no more similar than that of ordinary brothers and sisters. Environment, of course, is as similar for fraternal twins as it is for identical twins. If environment were the determining factor in intelligence, therefore, correlations between fraternal twin IQ's would be the same as those for identical twin IQ's. Studies show consistently that this is not the case: there is a much higher correlation between the IQ's of the identical twins.

A study of this type conducted in England supports the hypothesis that intelligence is determined largely by heredity. It also indicates, however, that the various primary mental abilities which go to make up general intelligence vary in the degree to which they are inherited.

Subjects were fifty-six pairs of like-sexed twins, some fraternal and some identical, ranging from eleven to fifteen years of age. They were given Thurstone's Chicago

Tests for the Primary Mental Abilities together with another test designed primarily to measure speed and intellectual level. The correlations between the scores of identical twins were much higher than between those of fraternal twins on the Thurstone test as a whole and on each of the primary mental abilities except number, on which the identical twins made only slightly more similar scores than the fraternal, indicating that numerical ability depends considerably on environment. The highest correlations were obtained between the identical twins on the verbal and fluency factors, indicating that these may be highly hereditary. Space visualization, like numerical ability, had a somewhat lower correlation in identical twins than had verbal comprehension, word fluency, or reasoning factors. Surprisingly, the speed test showed a lower correlation for the identical twins than the fraternal twins; this would seem to indicate that speed probably does not depend upon inherited structures (Blewett, 1954).

The most ambitious study of the relative contribution of heredity and environment in shaping of intelligence under normal conditions of life involved 2935 male twin pairs who appeared for induction into military service in Sweden. On a test of general intelligence the correlation between monozygotic twins' scores was .90 and that for dizygotic pairs .70. These values are almost the same as those for body height (Husen, 1960). These findings are in essential agreement with other studies conducted in different countries over the last forty years (Nichols, 1965). Taken as a group, these studies show conclusively that, given an environment that is equal for the two members of a twin pair, those twins who are also equal in heredity will be clearly more similar in measured intelligence than those who differ somewhat in heredity. Such an analysis, however, does not tell us anything about the relative contributions of each factor.

One way to determine the exact contribution of heredity and environment would be to separate a random sample of identical twins at birth and assign each to a foster home at random, so that each home would receive two unrelated babies. Under these conditions a simple statistical analysis would tell us how much each factor contributes. To measure the contribution of environment one would correlate the scores of nonsiblings in foster homes, since this would give us identical environment with dissimilar

heredity. To measure the effects of heredity we would correlate identical twins in different homes. The possibility that such an experiment will ever be conducted in the free world is extremely remote.

The Influence of Culture

Different environments apparently foster the development of different patterns of ability. Unfortunately, there is too little evidence on this important subject, but indications are that a particular environment—because it calls for particular adaptive behavior—will bring about accentuated development of certain abilities. This is shown most dramatically in comparisons of abilities typical in different cultures. We shall note in Chapter 9 the different perceptual skills developed in different cultural settings. Comparisons with regard to other abilities have been equally revealing. One such comparison was made between intelligence test scores of beginning college students in Ceylon and the United States.

At the time of college entrance, 212 students in Ceylon were given intelligence tests and their performance compared with that of American college entrants. The first difference was the consistent superiority of the Ceylonese men, who made a median centile score of 57.0 when compared to the United States norms, in contrast with a median centile score of 44.4 for the women. In the United States the median centile score for both men and women is, of course, 50.

But the most striking result appeared on the language items. The Ceylonese men made a median centile score of 76.8 and the women a median centile score of 71.5, as compared to the American 50, despite the fact that the test was given in English, which is not their native tongue. On the nonlanguage items, by contrast, again compared with an American median of 50, the medians were only 12.0 for men and 5.6 for women (Straus, 1951).

The culture of Ceylon may well explain these differences. Ceylon, like other parts of the Far East, emphasizes verbal achievement. Early education consists of verbal, rote learning. The poet and the philosopher, not the scientist and the engineer, are the most admired citizens. Thus the young students develop remarkable

verbal ability but are deficient, by Western standards, in certain nonverbal skills.

Fair tests for different cultural groups. As test makers have tried to compare individuals from different socioeconomic groups, they have been faced with the crucial problem of finding test materials that do not favor or penalize one group or another. The currently used tests of intelligence, for example, were made up by members of the higher socioeconomic groups, and there is, therefore, a real danger that they unfairly penalize those who are members of the lower groups. For example, it seems likely that the child from a family which does not value "book learning" and has no books in the home will be at a disadvantage on questions that involve verbal skill and knowledge of precise meanings of words. Also he will probably be rather uninterested in such questions and may make less effort to answer them correctly than a child whose parents use language well and value reading. Again, children of different cultural backgrounds might answer quite differently a question such as "What would you do if you found a purse with \$5.00 in it?" or "Look at this picture and tell me what's funny about it."

On the Wechsler Intelligence Scale for Children, described on page 155, it was found that children from higher economic levels of society made significantly higher mean scores than children from lower economic levels at the second-grade level (Estes, 1953). By the fifth grade, however, these differences were greatly reduced. It may be that as children grow older, other cultural influences—such as television, Sunday Schools, and the public schools themselves—tend to offset some of the effects of poverty and a poor home environment.

Culture free vs. culture fair. It is impossible to devise test items that do not utilize some past experience. But although tests can never be entirely culture free, efforts are being made to design tests which at least will be culture fair. These attempts have not been successful as yet. One such test is the Davis-Eells Games, a series of problems with content not limited to the experience of any socioeconomic level. Some recent studies, however, suggest that the Davis-Eells has no real advantage over other

tests as far as culture fairness is concerned. Just as much difference between socioeconomic groups appears on the Davis-Eells as on the conventional California Test of Mental Maturity (Drake, 1959).

Three major steps have been suggested for constructing tests to be used with individuals from all socioeconomic levels in the United States (Davis and Havighurst, 1948):

1. Test makers must choose problems that are equally common and equally motivating to all socioeconomic groups, and they must express these problems in symbols that are culturally common.

2. They must sample a far wider range of mental activities than they now do and thus greatly reduce the importance given to academic types of problems. In the past many intelligence test items have been selected because of their correlation with ability to do conventional schoolwork, an ability particularly prized in the culture of the upper economic groups. Too often they have neglected the useful and practical abilities valued in the culture of the poorer classes.

3. Test makers, to be sure they are really testing intelligence, must discover an objective method of validating test items to replace the validation now used—considering an item valid if it correlates highly with ability to do schoolwork.

Until these steps are taken and surveys are made with the resulting tests, we cannot know just how much to discount the findings of studies in which people of different backgrounds have been given the same tests.

Life Conditions Influencing Intelligence

Psychologists know that there are several special conditions that can affect the development of intelligence. On the other hand, many conditions generally thought to have a bearing upon intelligence have none at all.

Sex differences in intelligence. Early studies of differences in IQ between boys and girls were essentially negative in that no clear differences were revealed. More recent studies, however, using modern measuring instruments, have re-

vealed some interesting differences. These have made use of tests of primary mental abilities, which, as we have seen, are sharper tools than the general IQ tests.

In a study in which primary mental abilities tests were administered to three successive junior-high classes in Brookline, Massachusetts, it was found that the boys surpassed the girls markedly in spatial intelligence, whereas the girls clearly surpassed the boys in rote memory, reasoning, and word fluency. On verbal comprehension, the boys did somewhat better than the girls on two of the three tests. No difference in numerical ability was found between the two sexes (Hobson, 1947).

In another study the Thurstone battery of primary mental abilities tests was given to all the thirteen-year-olds in a midwestern community of 6000 inhabitants. It was found that the girls did better than the boys in number, word fluency, reasoning and memory. The boys excelled the girls in spatial ability. No significant difference was found on the verbal comprehension test (Havighurst and Breese, 1947).

A more recent study showed no sex differences at the eighth-grade level, but when the same students were retested at the end of the eleventh grade, girls were superior to boys in verbal comprehension, reasoning, number, and word fluency. Girls also proved to be less consistent than boys in performance, and their ability test scores showed a lower correlation with school achievement (Meyer and Bendig, 1961).

A study of college students indicated a superiority for the men in solving problems which required ingenuity and logic (Sweeney, 1953).

Putting together the results of these studies, it seems reasonably safe to conclude that boys excel girls in *spatial intelligence* and most kinds of *problem solving*, whereas girls excel boys in *memory*, *reasoning*, *word fluency*, and *numerical ability*. Since boys are better in some primary abilities and girls in others, these differences cancel each other out when general tests are used, with the result that no difference between the sexes is found in overall level of intelligence.

Health. There has long been a popular notion that the child who is superior in intelligence

will be inferior in physical health, and vice versa. Numerous studies have shown that this belief is false and that good general health usually goes with high intelligence. Apparently superior heredity is a factor in both mental and physical superiority (Terman, 1925).

Contrary to popular belief, studies show that removal of diseased tonsils and adenoids has no effect on level of intelligence, except insofar as any improvement in a child's physical health makes it easier for him to work up to his full mental capacity (Rogers, 1922; Lowe, 1923).

As we saw in earlier chapters, the endocrine glands produce chemical substances which profoundly affect both physical growth and personality development. The relation between these secretions and intelligence is only beginning to be investigated. As we have seen, a thyroid deficiency in infancy, resulting in cretinism, seriously interferes with the initial development of intelligence. Thyroid deficiency occurring after the age of two years also lowers intelligence, but this condition can be corrected with proper treatment. There is no evidence that pituitary disorders lower intelligence; in fact, patients with a severe pituitary deficiency (known as *Fröhlich's syndrome*) may actually be above average in intelligence (Schott, 1938).

Investigations of the effects of nutrition on intelligence have shown that improving the diet of malnourished children does not raise their intelligence. It has been shown, however, that a child's intelligence may be affected by the quality of the mother's diet during pregnancy (Harrell, Woodyard, and Gates, 1955).

Premature birth is another fact which is now known to have no effect on level of intelligence. It may, however, have an adverse effect on emotional adjustment, both because incubator raising precludes human contact in early infancy, and because parents tend to continue to be overprotective of children who were delicate at birth (Howard and Worrell, 1952).

Family size. Studies investigating the effects of family size on intelligence have found a low negative correlation between intelligence and number of siblings, especially in lower economic groups (Gille, 1954; Heuyer, 1950). Contributing to this relationship may be the fact that among these groups people of lower intelli-

gence tend to have more children; thus children from larger families are likely to suffer from poor heredity as well as a poor psychological environment. Another possible explanation

is that in large families there is less money per child for food, education, medical care, and other needs, as well as less contact with the parents.

OTHER ABILITIES

Our discovery that intelligence is composed of several factors leads us to ask: what about the particular skills of a watchmaker? of an athlete? of a musician? Few would argue that these individuals do not have some special ability or abilities other than intelligence. Are these general abilities, or can we expect to find varying patterns of more specific abilities?

Psychomotor Abilities

In recent years, psychologists have been devoting increased attention to the measurement and understanding of a set of human abilities involving strength, coordination, and dexterity and collectively called the *psychomotor abilities*. This work has been spurred in part by the advent of miniaturization in the electronics industry. Assemblers must work with parts which are so small that they must be viewed through powerful magnifying lenses and handled with delicate tweezers—obviously no job for a person with shaky hands! Tests have been developed to select employees for these jobs, as well as for others which require a high degree of manipulative ability. Psychologists have subjected these and other tests to factor analysis, in order to isolate primary psychomotor abilities.

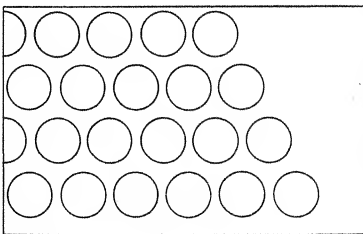
In one such study twenty-two printed and apparatus dexterity tests were administered to 760 Air Force technical trainees. Correlations among all the tests were computed and factor analyzed. Five independent factors were found: *finger dexterity, manual dexterity, wrist-finger speed, aiming, and speed of arm movement* (Fleishman and Ellison, 1962).

Finger dexterity is the ability to make precise, coordinated movements with the finger

tips, such as those required of a watchmaker. In this study it was measured primarily by the Purdue Pegboard. The subject's score is the number of pegs he places in thirty seconds.

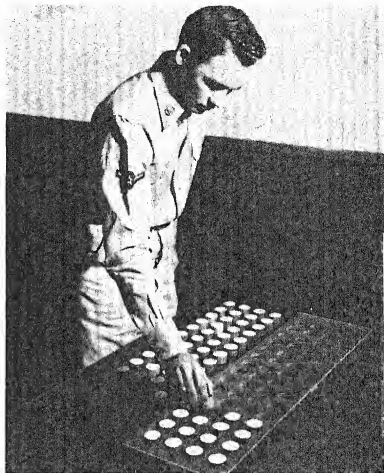
Manual dexterity involves coordinated movements of the hands and arms. These movements are not as fine as those of finger dexterity. Manual dexterity was found to be the major factor measured by the Minnesota Rate of Manipulation test. This apparatus also measures finger dexterity and aiming.

Wrist-finger speed is the ability to make wrist-flexing and finger movements rapidly. It is a matter of speed, rather than precision, and is best measured by having the subject put three dots in each of a series of 3/8 inch circles:



Aiming is the ability to move the hand rapidly and accurately from one spot to another. It was found to be best measured by a paper and pencil test in which the subject is required to place a dot in each of a series of circles 3/16 of an inch in diameter. His dots must be completely within the circles, without touching the sides. His score is the number of circles correctly dotted in 30 seconds.

▲ In the variant of the Purdue Pegboard Test shown here (left), the examinee must make as many complete peg-washer-collar-washer assemblies as possible in the time allowed. Other variants include putting pegs into the holes as rapidly as possible with the right hand alone, the left hand alone, and both hands at once. In the Minnesota Rate of Manipulation Test (right) the examinee is shown putting 60 cylindrical blocks into the proper holes as quickly as possible. In another test with the same apparatus, he must take each block out with one hand, turn it over with the other hand, and replace it in the same hole, moving as rapidly as possible.



The final factor, speed of arm movement, is defined as the "speed with which a subject can make a series of discrete, gross arm movements." It was best measured by a test in which the subject strikes with a wired metal stylus at targets of varying sizes seen through ten metal-lined holes in a wooden board.

The results of this and other dexterity studies, as well as studies involving strength and physical fitness, have been analyzed and placed in a systematic framework, similar to the "structure of intellect" shown earlier. In this framework, shown on page 172, the various factors have been classified with respect to the part of the body involved and the type of ability. The columns in the table show the kinds of abilities

and the rows show the parts of the body involved. Empty cells suggest undiscovered or unmeasured primary psychomotor abilities (Guilford, 1958).

In addition to the abilities provided for, there may well be other factors in the psychomotor domain. As more tests are devised and more research is conducted, this classification system may have to be extended or revised.

Athletic Ability

Is there such a thing as all-round athletic ability? We know that certain individuals excel in a large number of sports, while others fail in

all. We cannot assume on the basis of this fact alone, however, that there is a general athletic ability that makes for excellence in all sports. Even if correlations between the various athletic abilities were zero, it would be possible for a few individuals to excel in all of them through chance association of the desirable abilities. We cannot answer this question by pointing to a few all-round athletes who may or may not follow the general rule but must examine a cross section.

A number of studies have been conducted in this area, making use of the method of factor analysis. Positive correlations have been found between tests of athletic proficiency, indicating that these abilities are somewhat interdependent (Brogden and Harman, 1948).

One British study found a general or basic factor for athletic ability highly correlated with general health, plus three subfactors—running, jumping, and throwing (Highmore and Taylor, 1954).

Two American investigators have studied the type of power involved in jumping to determine its relation to intelligence and general athletic ability.

A "jump and reach" test was used on 1013 high-school boys, the best of three jumps being counted in

each case. Each boy stood facing a vertical board on which horizontal lines were marked one inch apart and extended his arm upward as far as he could. Then he was asked to jump and reach as high as possible. The difference between the height he could reach standing still and the height he could reach jumping was his score.

It was found that jumping power had no relation to intelligence. The lettermen of the group, regarded as "athletic," made significantly better scores than did the nonathletic members of the group, suggesting that the kind of power measured by this test is an important component of athletic ability. This type of power is more highly correlated with achievement in track, swimming, basketball, and baseball than with achievement in boxing, wrestling, or tennis (Burley and Anderson, 1955).

These studies show that there is a consistent tendency for a person who excels in one type of athletic activity to excel in others too. Apparently there is such a thing as all-round athletic ability. This may well be due to the fact that most types of athletics require the same primary psychomotor abilities.

Musical Ability

An early study reported the correlations between measurements of pitch discrimination,

PSYCHOMOTOR FACTORS

parts of body involved	type of ability						
	strength	impulsion	speed	static precision	dynamic precision	coordination	flexibility
gross	general strength	general reaction time		static balance	dynamic balance	gross bodily coordination	
trunk	trunk strength						trunk flexibility
limbs	limb strength	limb thrust	arm speed	arm steadiness		arm aiming	leg flexibility
hand		tapping			hand aiming	hand dexterity	
finger			finger speed			finger dexterity	

sense of time, tonal memory, and other elements which represent essential abilities in learning to play musical instruments. Their intercorrelations were found to be so low that there was no evidence of a cluster representing general "musicality" (Scashore and Mount, 1918). All in all, the evidence from this early investigation and from more recent ones indicates that there is no such thing as all-round musical ability. Good musicianship seems to depend, rather, on the individual's being strong in several basic abilities.

The fact that an individual is high in a few of these elementary abilities does not mean that he will be high in the others. Certain of the needed abilities of the musician, however, do tend to go with certain others. People who are good at discriminating pitch, for example, are likely to excel in memory for combinations of tones. Rhythm, however, does not seem to be correlated with pitch discrimination. The senses of pitch, intensity, time, consonance, rhythm, and memory for tones are all unrelated to general intelligence (Fracker and Howard, 1928; Ross, 1936).

Artistic Ability

Artistic ability, like athletic and musical ability, seems to be independent of general intelligence (Meier, 1942). Although there have not been enough studies to answer the question of whether there is all-round artistic ability, there is some evidence that creative artistic ability, as indicated by the ability to draw, is correlated with art appreciation.

Over a six-year period the Meier Test of Art Appreciation, illustrated here, was given to groups of college students in a laboratory psychology class. ♦ Altogether 194 subjects were tested. The students were also asked to draw a large silver-plated elephant which was set up before the class against a black background. Twenty minutes were allowed for the drawing, and the students were urged to use the entire time and do the best they could even though they were sure they could not draw well. Some students had had more art training than others.

The drawings were evaluated by the students themselves and by three art experts. A correlation of .59 was

♦ In the Meier Test of Art Appreciation the subject looks at a series of 100 pairs of pictures and indicates which picture in each pair has the greater esthetic appeal. After he judges the entire series of pictures, the experimenter determines his centile score.



obtained between drawing ability, as rated by other students, and performance on the Meier Test of Art Appreciation. A correlation of .37 was found between the experts' ratings of the student drawings and the students' scores on the test. This would seem to indicate that art appreciation is not entirely independent of drawing ability (Crannell, 1953).

This correlation might be partially the result of learning, since students with training in studio art would also be likely to have had some training in art appreciation.

For none of these abilities—psychomotor, athletic, musical, or artistic—have there been definitive studies on the relative roles of heredity and environment, such as those carried out in the area of general intelligence.

UNDERSTANDING THE WHOLE PERSON

When all the measures are in, the psychologist still must try to put them together in such a way as to show the overall pattern of the various characteristics measured. For his test scores to be useful, he needs to know the areas of greatest relative strength and weakness of the individual and how this particular pattern of traits compares with those of other people.

Profiles

Many psychologists make use of a profile, or *psychograph*, which makes it easy to picture an individual on the basis of his several scores and to "type" him in terms of fitting a particular pattern of aptitude and personality traits. At the side of the psychograph are listed the traits for which measures have been obtained, and the person's standing on each trait is indicated in terms of a centile score by a dot at the appropriate point along the horizontal line extending from the trait name. Such a profile shows at a glance the areas in which a person is above the average and those in which he is below the average of a comparison group. It thus enables the psychologist to study the individual in comparison with other people in terms of relative strengths and weaknesses.

A psychograph of a temperament pattern gives a better picture of the total personality than could be obtained from considering individual trait scores one at a time. For example, a person very high in self-assurance and at the same time high in agreeableness would have a vastly different personality from that of a person who was equally dominant but very low in agreeableness. A particular pattern is often more important for success in a particular vocation than high scores on a few specific traits. Profiles are often used by employers to help decide whether to hire a particular applicant or to promote or transfer a present employee. By comparing a profile of an applicant with the profiles of successful workers on the specific job being considered, they can gauge the likelihood

that he will be successful in that job. Educators and clinicians also find profiles helpful in advising students or clients with regard to choosing a vocation.

On page 175 is the psychograph of an applicant for a position as sales engineer with a firm dealing in mechanical products. This young man was given a number of the psychological tests described in this chapter, plus a test of sales comprehension; his centile scores are plotted on the psychograph. Following is a résumé showing what such a profile can mean to a psychologist who is well trained in both the area of testing and the area of job requirements.

This applicant is not recommended for the position of sales engineer, despite his high intelligence, because he lacks sales knowledge and is only average in interest in selling (persuasive interest). He is an overactive person (high in energy) who easily becomes enthusiastic about his work, but after a short period is inclined to lose interest (low in restraint). Mr. Jones is basically distrustful of people and likes to push them around "for their own good" (high social service, high power, and low trusting). He is emotionally unstable, and even though he distrusts people he seeks them out because he is afraid to be alone.

Mr. Jones was trained as a geologist and shows a strong scientific interest. By contrast, he has a lower interest in the world of business, being more like a social worker or an artist in his philosophy of life. If employed as a sales engineer, Mr. Jones would be a problem case.

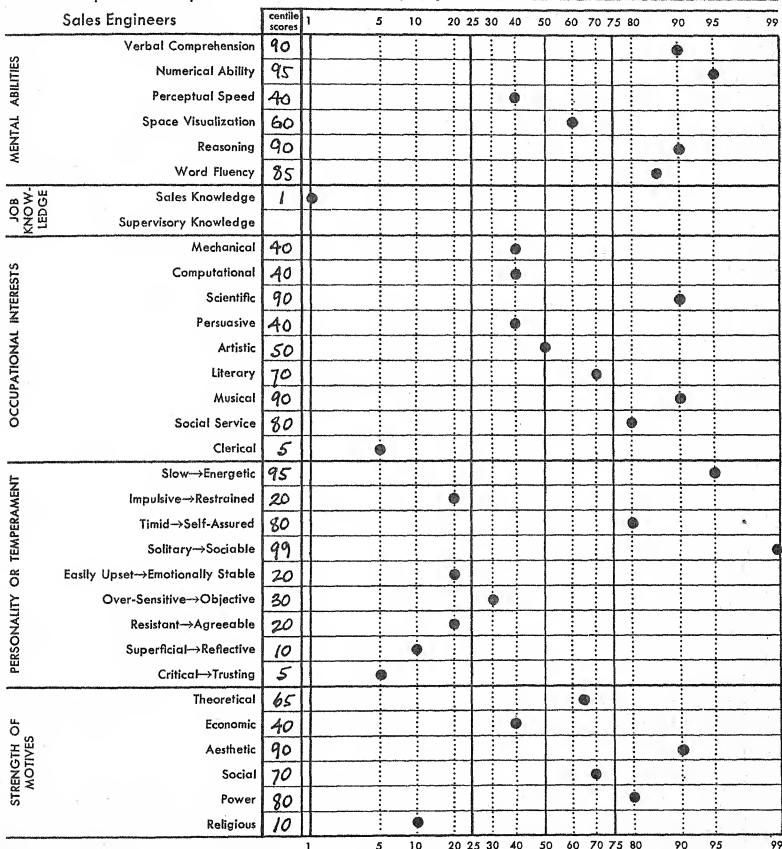
The Meeting of the Ways

For a psychologist, the best method of understanding the person is the one that yields the most accurate prediction of his future behavior. If there is consistency within the personality—and almost all psychologists are in accord that there is—it should be possible by studying the person today to make a better-than-a-guess prediction of what he will do, think, and feel tomorrow or next year. In general, the factored tests have done a much better job of prediction

PSYCHOGRAPH OF AN APPLICANT

Comparison Group:

Sales Engineers

Centile Profile of Richard Jones

than have the "projective" tests, with other types of tests ranking somewhere in between.

Man is more than the sum of his (tested) parts. We have seen numerous evidences that the whole man is more than the sum of his parts. Test scores show only how individuals rank with regard to dimensions they share in common—where an individual stands in relation to others who have taken the test. They do not show how a given trait functions in an individual's personality. No listing or profile of test scores gives us the unique dynamic pattern that determines the role of each "asset" and "weakness" in the individual's actual functioning and makes him different from every other person.

Measured traits interact. In earlier days psychologists tried to measure only individual parts of personality in the hope that the individual measurements could be added together to arrive at a total and predict future behavior. This worked only fairly well in the assessment of aptitude and was even less effective in the assessment of motivation or personality.

Two psychologists who have made an intensive review of the literature on the use of tests for prediction conclude that: "The general point to be made is that prognosis research seems to require a different, more complex, mathematical model, and thus a more complex research design, than has been generally used so far. Specifically, the one-stage design, where a predictor is correlated with an outcome measure, would appear to be inadequate in this field." (Fulkerson and Barry, 1961).

The same trait in two different personalities may produce quite different behavior. It is the whole constellation on which predictions must be made, not individual traits. For example, Mr. A is at the first centile on the Resistant→Agreeable continuum, as is Mr. B. They work side by side in the same office. Mr. B is very high on the Slow→Energetic factor and near the impulsive end of the Impulsive→Restrained factor. He is also very high in self-assurance. Mr. A, in contrast, is at the slow end of the Slow→Energetic continuum and at the restrained end of the Impulsive→Restrained dimension. He is also very timid. Of these two

men, who are equally resistant, Mr. B is much more likely to get into arguments with his office colleagues.

The same findings from different approaches. Until recent years there has been much controversy and some bitterness between psychologists in the Freudian tradition, who depend on clinical observations of and insight into the whole person, and those who, in the tradition of Guilford and Cattell, measure the parts in isolation and try to put these measures together to understand the whole person. Most psychologists have taken a middle-of-the-road position, using what they could from both approaches and hoping that ultimately the two will find common ground. This sort of thing has happened in other sciences—even in the exact science of physics where controversy once raged over whether light should be thought of as waves or particles.

There is recent evidence that such a rapprochement is beginning already in the study of human personality dynamics. One psychologist, using the methods of factor analysis, has isolated factors which appear to be the same as the superego, ego, and id of the Freudians (Cattell, 1957). In general, it is encouraging to notice that two such different approaches to the study of human personality are beginning to arrive at similar concepts.

CHAPTER SUMMARY

Psychologists who do not feel that the clinical approach to the study of personality is adequate have developed objective-measuring instruments for personality study. Such an instrument must be *valid*: it must really test what it was designed to test. To be *valid*, it must also be *reliable*: it must give consistent results if repeated. To be *reliable*, in turn, it must be *objective*: it must give the same result when scored by different persons. A measuring instrument should be *standardized* on a large group of subjects representative of those for whom it is intended. Psychological measure-

ing devices fall into three categories—*measures of achievement*, *measures of aptitude*, and *measures of motivation*. On the basis of form they may be classified as interviews, projective techniques (both of which were discussed in the previous chapter), and the more objective *rating scales*, *behavior samples*, *self-inventories*, and *tests*.

In order to interpret raw scores, it is necessary to study their position relative to the distribution of the trait being measured. Since there is no zero point for psychological traits, psychologists use measures of central value—the *arithmetic mean*, or average; the *median*, or midpoint; and the *mode*, or score most often earned. Measures of variability include the *range* and the *standard deviation*. *Standard scores*, based on the number of standard deviations the raw scores are from the mean, may be used to compare performance on several different tests. The distribution may be divided into equal parts called *partiles*, which provide a convenient way of presenting the results of test standardization for use in understanding an individual's performance.

Another statistical measure, the *correlation coefficient*, indicates the degree to which two traits go together. This coefficient is valuable in prediction and as a measure of test validity and reliability; however, it must be remembered that high correlation does not mean that one trait causes the other.

Two of the major approaches to the objective measurement of personality are the *philosophical approach*, typified by the Study of Values test; and *factor analysis*, which has identified a number of objectively measurable personality dimensions. Two large groups of personality factors have been thus identified—*hormetic* and *temperament*. The *hormetic* traits are the direct motivational aspects of the individual's personality, while the *temperament* traits describe his characteristic manner of operating.

Objective devices based on observation of behavior include *rating scales*, which may be relative or absolute, *behavior sampling*, and *self-inventories*. Both types of rating scale are subject to the *halo effect* and to *stereotypes*. The *forced-choice scale* is an attempt to offset the leniency error. In behavior sampling the

psychologist observes the individual's behavior in a typical situation.

One of the most important traits measured by psychological tests is *intelligence*. The Stanford-Binet, successor of the earliest intelligence test, the Binet scale, measures general intelligence expressed as an *intelligence quotient*, or *IQ*. This *IQ* is based on a ratio between an individual's mental and chronological ages and thus shows his rate of mental growth as well as his position relative to the average. The Stanford-Binet is primarily a measure of verbal intelligence; nonverbal ability may be measured by *performance tests*.

Intelligence is distributed among the population according to a normal curve, with about two thirds of the population falling in the "average" range (between 84 and 116 on the Stanford-Binet test). The mentally gifted have been shown not only to be superior in level of accomplishment and earning power but also to have lower suicide, insanity, and divorce rates than those of average intelligence. At the other end of the scale, mental defectives can be classed as *mildly retarded* (IQ 50-70), *moderately retarded* (35-50), *severely retarded* (20-35), or *profoundly retarded* (below 20). Many studies have shown that the *IQ* is relatively constant, unless environment changes markedly.

In recent years general intelligence has been shown to be composed of a number of *primary mental abilities*, which are studied by factor analysis. Spearman and Thurstone were pioneers in this study, and more recently Guilford has classified all intellectual abilities into a systematic framework, the *structure of intellect*.

Psychologists have shown that *heredity* is the most important single factor in determining intelligence. Changes in *environment* often have some effect on *IQ*, especially in very young children, but the amount of improvement possible seems definitely limited by heredity. Various studies have shown, however, that the development of specific abilities, such as verbal ability and number ability, is influenced significantly by cultural factors. This makes it very difficult to devise tests that are equally fair to all cultural groups.

Boys have been found to excel girls in *spatial* intelligence and most kinds of *problem*

solving, whereas girls excel in *memory*, *reasoning*, *word fluency*, and *numerical ability*. Among special factors studied in relation to intelligence, glandular imbalance and size of family seem to have some adverse effect, as does inadequate nutrition of the mother during pregnancy.

The discovery that intelligence is composed of several specific abilities has led to various attempts to analyze other human abilities. In recent years *psychomotor abilities*, which involve strength, coordination, and dexterity, have received increasing attention. Thus far there has been no evidence of an all-round *musical ability* or *artistic ability*, but studies have indicated the probable existence of all-round *athletic ability*.

If information gained from objective personality measures is to be useful, test scores

must be put together in such a way as to show the overall pattern of the characteristics measured and reveal the individual's strengths and weaknesses. For this purpose many psychologists use a *profile*, or *psychograph*, which shows the person's standing on each trait in terms of centile scores.

The best method of understanding the person is the one that yields the most accurate prediction of his future behavior. In general, the factorized tests have proved best in this respect. But no list of test scores can give us the unique dynamic pattern of an individual's personality. One reason is that measured traits interact. It is encouraging to note that psychologists who try to understand the whole person by clinical observation and those who concentrate on isolating individual traits are drawing closer together.

Part Three How People Change Through Learning

Chapter 6 Defining and Measuring Learning and Retention

Chapter 7 The Management of Learning and Retention

We have seen how people differ from one another both in their inherited structures and in their opportunity to learn. Man lacks the precise instinctive behavior patterns found in lower animals, but his capacity for learning is much greater than theirs and plays a part in almost all of his activities. All man's special skills, attitudes, beliefs, and prejudices are products of the learning process—in fact, there is no single human act above the reflex level that cannot be modified in some important way through learning. Learning is the core of human understanding and adjustment. We learn by living and we live by learning.

Although much learning comes from textbooks, libraries, and laboratories, there is practically no life experience which does not leave some stamp of learning on the individual. Indeed, before the child is ever sent to school he is, in a sense, already a "learned" person, equipped with an extensive repertoire of behavior patterns which he has acquired in the environment of the home, the church, or the playground. Learning begins even before birth and continues to make changes in the individual's personality and behavior throughout life; for although it may sometimes be more difficult to "teach an old dog new tricks," there is no age limit on our ability to profit from experience.

The lower animals, too, can learn to adjust to various situations. A primitive sort of learning has even been demonstrated in the one-celled paramecium, one of the lowest forms of animal life. Compared with that of man, however, the

capacity of lower animals to learn adjustive responses is severely limited. Because of this, the lower animals are much less free of their physical environment than we are.

It does not require the experimental observations and theoretical formulations of the psychologist to point out the importance of the learning process in our adjustment to our changing environment. Man's awareness of his need to learn is reflected in the time, energy, and money he invests in trying to learn whatever he believes will make him more adequate in his vocational, social, emotional, and intellectual life.

In the next two chapters we shall consider some of the established facts about learning and forgetting and some of the principles which you as a student can apply in managing your own learning. For just as some manufacturers fail because of poor management which pushes up their costs, so some students fail because they do not properly organize and manage their learning effort.

Psychologists assume that learning involves certain changes in the organism's central nervous system, although the nature of such changes has not yet been identified. At best, learning can be observed only indirectly, through the changes it brings about in the individual's ways of responding to stimuli. When we say that a person has learned to perform a particular act, we really mean that we observe certain changes in his behavior which lead us to assume that learning has taken place.

Chapter 6

Outline

KINDS OF LEARNING

CONDITIONING
DISCRIMINATION LEARNING
IMPRINTING
VERBAL LEARNING
MOTOR SKILL LEARNING
MIXED LEARNING TASKS
ATTITUDE LEARNING

NEURAL BASES OF LEARNING

CHEMICAL CODING: BREAKTHROUGH OR INTERESTING SPECULATION?
WHERE DOES LEARNING TAKE PLACE IN THE BRAIN?
MECHANISMS OF MEMORY STORAGE

MEASURING LEARNING

CRITERIA OF LEARNING
LEARNING CURVES

MEASURING RETENTION AND FORGETTING

THE METHOD OF RECALL
THE METHOD OF RECOGNITION
THE METHOD OF RELEARNING
THE COURSE OF FORGETTING
DO WE EVER FORGET COMPLETELY?

MAJOR THEORIES OF LEARNING

HULL'S FORMAL THEORY OF LEARNING
SKINNER'S APPROACH TO LEARNING
WATSON AND BEHAVIORISM
GUTHRIE AND CONTIGUITY THEORY
THORNDIKE'S REINFORCEMENT THEORY
COGNITIVE THEORIES OF LEARNING
CURRENT TRENDS IN THEORIES OF LEARNING

Chapter 6 Defining and Measuring Learning and Retention

People usually think of learning as improvement from practice. This is not entirely correct. While no one would deny that learning often results in improvement, it can bring about undesirable changes too. The child who is taking piano lessons can learn to play wrong notes. The stenographer can learn to misspell words. The neglected child can learn to gain attention by means of a temper tantrum. The popular definition of learning must be expanded to include the acquisition of any new response pattern, desirable or undesirable. Broadly defined, *learning is a process which brings about changes in the individual's way of responding as a result of contact with aspects of the environment.* Behavioral changes induced by drugs, brain injury, or maturation are not considered to involve learning.

What actually takes place during learning is still a mystery, as is the question of whether there is one learning process or many and the related question of whether there is an all-round learning ability. In this chapter we will examine several kinds of learning studied by psychologists, as well as attempts to identify the neural mechanisms involved in learning and remembering. Then we will discuss the ways in which learning and remembering are measured and the general course of learning and forgetting under different conditions. Finally, we will briefly discuss some of the major theories of learning.

KINDS OF LEARNING

The procedures used by psychologists to study learning have become sufficiently stand-

ardized to permit psychologists working in different laboratories to compare and build on each other's findings. Research has been centered for the most part on the following kinds of learning: *conditioning, discrimination learning, imprinting, motor skill learning, and attitude learning.*

Conditioning

Conditioning is considered by many psychologists to be the fundamental form of learning, underlying the development of some of the earliest response patterns in newborn infants. Conditioning has been demonstrated to occur even before birth. (An experiment was described in Chapter 3 in which fetuses were conditioned to respond to vibratory stimuli.) Through conditioning, the organism's responses to a great variety of stimulus situations are changed. Differences in the way these new patterns of response are acquired has led to a distinction between two kinds of conditioning—*classical* and *instrumental*.

Classical conditioning. The best-known experiment in classical conditioning was performed by a Russian physiologist and Nobel Prize winner, Ivan Pavlov, who accidentally discovered the conditioned response while performing a series of routine physiological experiments (Pavlov, 1927). Pavlov was studying digestion and salivation in dogs, using an apparatus which collected and measured the secretions of live animals by means of tubes implanted in the stomach or cheek. In these experiments, meat powder was placed in a dog's mouth and his salivary response to the food was observed. Pavlov's assistants reported that after a number of trials with any particular dog, the animal

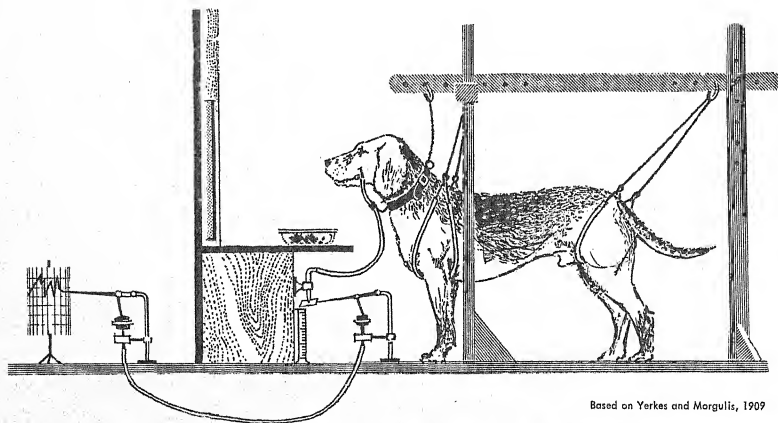
would begin to salivate when he saw the food, before it was actually placed in his mouth. Soon he would salivate at the sight of the food dish, and finally even at the sound of the assistant's approaching footsteps. Pavlov, realizing that this phenomenon was of great significance, changed the course of his investigations.

In the series of experiments which followed his chance discovery, Pavlov established the terminology that is still used to describe this type of learning. He applied the term *unconditioned stimulus* (UCS) to the food in the mouth, which elicited the inborn *unconditioned response* (UCR), salivation. He demonstrated that after repeated occasions on which a bell was sounded immediately before the food was placed in the dog's mouth, the bell alone came to produce the increased flow of saliva. Pavlov called this change in the animal's behavior a *conditioned reflex*, or *conditioned response*

(CR); the previously "neutral" stimulus, the bell, had become a *conditioned stimulus* (CS) by virtue of having been presented with the food. A neutral stimulus is one which before conditioning does not produce the response that the investigator is seeking. It may, of course, produce other responses, such as pricking up the ears or turning the head.

Any stimulus which elicits an inborn response may be used as an unconditioned stimulus in a classical conditioning procedure. In the case of the meat powder, the stimulus is a pleasant one, but an aversive stimulus may be used instead. For example, if the bell is followed by an electric shock to the paw, the unconditioned response to the stimulus—a flexion of the paw—soon comes to be elicited by the bell alone.

Pavlov's studies have had a widespread influence on the development of psychological thought. The process of conditioning has since

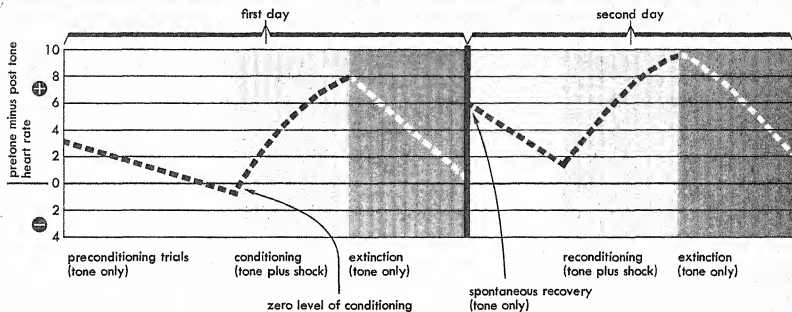


PAVLOV'S CONDITIONING APPARATUS

In Pavlov's early experiments, the dog was held in place with a harness while a dish of food was placed in front of him. A glass tube conducted the saliva from an opening in the duct of one of his salivary glands to a lever (center) which activated a stylus (far left); the stylus recorded the quantity and rate of salivary secretion on a revolving drum.

CLASSICAL CONDITIONING

This curve shows the conditioning of the heart rate of human subjects to the sound of a tone. After a series of preconditioning trials with the tone alone to get the subjects used to the apparatus, eleven conditioning trials were given, in each of which a one-second tone was followed after a six-second interval by an electric shock. During conditioning, the curve rose sharply, indicating an increasing difference between pretone and posttone rate. Then the shock was discontinued, and for eleven extinction trials only the tone was given; the curve dropped to near zero. The next day the tone alone again brought a strong conditioned response which again extinguished during ten unreinforced trials. When the shock was reinstated in a second conditioning series, the conditioned response rose to a higher level than the day before, following which a series of unreinforced trials again brought extinction.



Based on Natterman, Schoenfeld and Bersh, 1952

been demonstrated experimentally in countless experiments with both animal and human subjects, and the conditioned response has become a fundamental concept in modern psychology.

Extinction and recovery. Two other important phenomena discovered in Pavlov's investigations were *experimental extinction* and *spontaneous recovery*. As long as the dog was given food after the sound of the bell, his salivary response to the bell continued. But repeated soundings of the bell without reinforcement (the presentation of food) resulted in the gradual disappearance of the conditioned response, a phenomenon known as *experimental extinction*. When the dog was allowed to rest for a day after intense extinction training, however, salivation again occurred at the sounding of the bell—the conditioned response was recovered “spontaneously.” But on this second day, with

continued lack of reinforcement, the point of zero salivation was reached in fewer trials; and within a few more days the unrewarded trials resulted in permanent extinction of the conditioned response. Without such extinction training, a dog might retain the conditioned response for three or four months with little decrease in its strength. The typical sequence of classical conditioning and extinction experiments is shown in the graph. *

Continuous vs. partial reinforcement. One would expect that the more times a response had been reinforced, the more firmly it would be established and the more resistant it would be to being extinguished. One of the most interesting findings from conditioning experiments is that a response may be harder to extinguish following only periodic reinforcement than after training in which reinforcement has

been given on each conditioning trial. This intermittent reinforcement is called *partial reinforcement*. Perceptual clarity may be an important factor: when human subjects are conditioned with an electric shock, the phenomenon does not occur if, at the end of the training period, the subjects are simply told that there will be no more shock, making the following period clearly distinct from the one before. Here extinction is slower after continuous reinforcement (Bridger and Lopez, 1964). Recent studies on lower animals and human retardates (both lacking effective higher psychological processes) have not found slower extinction of conditioned aversive responses after partial reinforcement (Spence, 1966).

Generalization. Early in the course of his experiments Pavlov found that when a conditioned response to a specific stimulus had been learned, similar stimuli also would evoke the conditioned response. For example, a dog conditioned to one kind of bell might respond also to a bell of different tone or even to a buzzer. This phenomenon is known as *stimulus generalization*. The tendency to generalize or "confuse" stimuli is greater early in the training period than it is later. Generalization occurs most readily for stimuli of the same sensory mode—such as two auditory stimuli or two visual ones—but it may also take place between stimuli of different modes (Brogden, 1951). In general, there is less stimulus generalization as stimuli become increasingly dissimilar.

In the case of human beings, the phenomenon of stimulus generalization seems to be related to age and to the ability to discriminate between stimuli. One recent study, for example, found more stimulus generalization in children aged seven to nine than in children aged ten to twelve, who are able to make finer discriminations (Mednick and Lehtinen, 1957).

Often *response generalization* also occurs in conditioning. Thus animals trained to press a lever with one foot will, if that foot is tied down or otherwise restrained, press the lever with another foot or perhaps with the head. Or after a human subject has learned a series of "correct" response words to given stimuli, he may, on later tests of retention, give responses similar to the correct ones—"resting" instead of the correct word "restful," "misty" instead of

"filmy," or "gaiety" instead of "festive" (Underwood, 1948).

Secondary reinforcement and higher-order conditioning. The reinforcements referred to in the discussion thus far are considered *primary reinforcers* because they elicit an innate response without prior learning. In the case of classical conditioning they directly satisfy some need of the organism. In Pavlov's studies, for example, the dog's hunger need was satisfied by the unconditioned stimulus, the meat in the mouth. Thus there is a direct link between response, reinforcement, and the need state of the organism.

Under certain circumstances, stimuli that are not inherently rewarding may become reinforcers of new learning. Thus a dog that has learned to salivate at the sound of a bell may learn to do a trick when rewarded by nothing but the sound of a bell. Because of its association with the primary reinforcement of food, the sound of the bell has evidently become rewarding in itself. Such stimuli are called *secondary reinforcers*. Secondary reinforcers lose their reinforcing effect over a period of time unless they are themselves reinforced at appropriate intervals by being paired with the UCS.

Many goals in our everyday lives apparently owe their value to their secondary reinforcing properties. Money, for example, is of no significance until we learn to associate it with what it may buy. Thereafter it may come to be sought for its own sake. School grades, originally associated with approval from teacher or parents and with feelings of satisfaction at a job well done, may come to be sought as ends in themselves.

Once a conditioned response has been established, the conditioned stimulus may in turn be used as an "unconditioned stimulus" in setting up a conditioned response to a new neutral stimulus. This process is called *higher-order conditioning*, and it can sometimes be continued for several steps, although such responses are easily extinguished unless reinforced. It is viewed by many psychologists as a special case of secondary reinforcement.

In one early study it was found that as many as four orders of conditioning could be established. Using dogs, the experimenters first established a conditioned re-

sponse of foreleg flexion to a tone by pairing the tone with the unconditioned stimulus of shock to the dog's paw. The second-order response was established by pairing a light, as the new conditioned stimulus, with the tone, which had come to elicit the conditioned response of leg flexion. Next, when the light alone had come to elicit the response, a bell was paired with the light, and a new relationship between the bell and the leg flexion was established. Then the bell was paired with an electric fan, which, in turn, came to elicit the response. During this procedure the experimenters found it necessary occasionally to go back to the original reinforcement of shock following the use of the tone (Brogden and Culler, 1935).

Conditioned inhibition. In his experiments with dogs Pavlov also demonstrated *conditioned inhibition*, a phenomenon which has since been found to occur in human beings too.

In one study, the conditioned stimulus was a buzz followed by a strike on the cheek (the unconditioned stimulus), which produced an eyelid blink. After conditioning was established, so that the buzz alone was followed by the blink, a flash of light accompanied the buzz on some trials. When this happened, reinforcement was not given. Under these conditions the response to the buzzer given alone continued at the same level, but conditioned inhibition developed in response to the buzzer and light together: responses to the two together were weaker and less frequent than to the buzzer alone (Shipley, 1934).

Disinhibition. When a new stimulus is presented after a conditioned response has been extinguished, the conditioned response may temporarily reappear. In one experiment with human subjects, for example, it was found that when a salivary response to a flash of red light had been extinguished, so that the flash no longer produced any salivation, the sound of a buzzer just before the flash would reinstate the salivation in response to the flash (Razran, 1939).

Conditioning vs. paraconditioning. Sometimes during conditioning experiments changes in behavior occur that do not qualify as conditioning. These *paraconditioned* responses may easily be confused with true conditioning.

Sometimes in conditioning experiments with young animals, the subjects are developing so

fast that there are maturational changes in sensory-motor mechanisms during the period of the experiment. Changes in behavior during this period, then, cannot be attributed to the conditioning procedures because the change in maturational level may have been just as important or more so in producing the change in behavior. Perhaps conditioning took place and perhaps it did not. Only further, better controlled studies can tell.

In other instances changes in behavior during a conditioning experiment may be due to adaptation or fatigue rather than to learning. We know that repeated stimulation typically produces a decrease in response. Thus it is important in conditioning experiments to have a sufficient number of control groups to be sure that any changes in behavior that occur are really due to conditioning and not to fatigue or other factors.

The following study shows an effect that might be confused with conditioning.

Monkeys were frightened several times by a powder flash or by a paper blow-out snake. Following this series of stimulations, the sound of a bell also produced fright responses although it had not previously done so (Grether, 1938).

This phenomenon has been described as *pseudoconditioning*, since behavior similar to conditioned behavior is obtained without the typical pairing of stimuli which is the essence of true conditioning. Such behavior reflects a heightened state of excitement in which the organism does not make its usual discriminations among stimuli but makes the same response to whatever stimulus is introduced.

If a strong UCS like a shock is paired with a weak stimulus that alone produces only a slight response, the response to the weak stimulus alone may be increased. That this effect is not due to conditioning is indicated by the fact that the response remains unlike the response to the UCS, being clearly an increase in the original response to the weak stimulus. This effect is called *sensitization*. There is considerable evidence that any emotional arousal increases general sensitivity so that a weaker stimulus than usual will elicit a response and hence can play a role in conditioning.

Conditioning of lower organisms. Fish, cockroaches, and even the lowly earthworm have been successfully conditioned. A study of conditioning in a still lower species, the flatworm (planarian), showed especially interesting results. The planarian is the lowest organism on the evolutionary scale to have the following characteristics: true synaptic nervous transmission (see Chapter 2), definite encephalization (a concentration of neural components in the head region—a “brain”), and bilateral symmetry. At the same time, it retains a lower organism’s ability to regenerate lost parts. It can be cut into as many as six transverse sections and regenerate a complete organism from each section.

Fifteen planaria were conditioned to respond to a conditioned stimulus of light. A mild shock, which elicited a response of longitudinal contraction of the animal’s entire body, served as the unconditioned stimulus. When conditioning was clearly established, the animals were cut in half and then allowed to regenerate, which took from ten to fourteen days. Four weeks after the initial learning, all the regenerated halves were retested to determine the degree to which the original training had been retained.

Besides the experimental group, two control groups were used. The first consisted of planaria which were given no training but were cut in half and allowed to regenerate; this group was to eliminate the possibility of “sensitizing” the organism by the mere act of cutting. The second control group were trained in the same way as the experimental group but were not cut; this group was for the measurement of how much “forgetting” could be expected during the four weeks. After the rest period, both this group and the experimental group were retrained to the original response level, and the other control group were trained, for the first time, to the same criterion. The latter took as long to learn as the other two had taken during the initial learning situation, ruling out the possibility of increased sensitization from the cutting. Both the regenerated heads and tails showed as much retention as did the group that had not been cut (McConnell, Jacobson, and Kimble, 1959).

Since this study was conducted, it has been suggested that perhaps the light in the conditioning experiments cited above was actually a weak unconditioned stimulus. If so, the “learned” response would then be merely the

strengthening of an already present but weak reflex—sensitization rather than conditioning.

Experiments replicating earlier ones performed on conditioning of planaria found a significant difference between the experimental group (light and shock) and the normal response group (no light, no shock). Differences between the responses of light-stimulated (no shock) organisms and those of normal controls were not so pronounced, but were great enough to be significant (Halas, James, and Knutson, 1962).

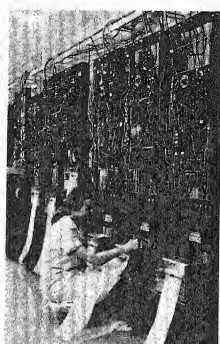
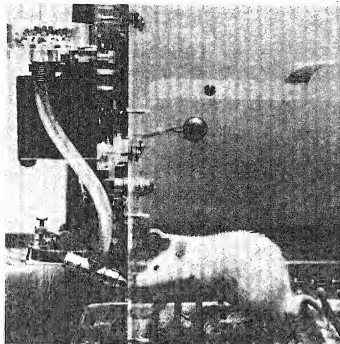
These findings indicate that both conditioning and sensitization are involved in the changed behavior of the planaria. In still more recent work, however, it was found that regenerated portions of extinguished planaria required no more trials than did nonextinguished planaria to achieve the same performance (Brown, 1964). This finding suggests that perhaps no true conditioning occurs in planaria and that previously reported results may be due entirely to sensitization rather than to conditioning. This whole issue is still unresolved, and in studying it we are very truly at a frontier of science.

Instrumental conditioning. As we have seen, classical conditioning essentially involves the presentation of two stimuli, a CS and UCS, in close temporal contiguity. The two stimuli occur quite independently of anything the subject has done.

There is another procedure, however, in which the UCS does not occur unless the organism first makes a specific response defined by the experimenter. Such conditioning is called *instrumental* conditioning, since the animal’s behavior is instrumental in bringing about the occurrence of the UCS. An example would be the dog who sits up and “begs” for a cookie. Instrumental conditioning is also, and increasingly, called *operant* conditioning.

In instrumental conditioning the UCS that is produced by the subject’s response is called a *reinforcer* whenever it is effective in increasing the frequency of occurrence of the response. Reinforcement in instrumental conditioning thus involves an increase in the frequency of a conditioned response—a response that produces a UCS. In Pavlovian conditioning, on the

▲ One form of the Skinner box (left) makes possible the study of either reward conditioning, through food pellets dropped into the receptacle, or aversive conditioning, through shock delivered to the floor grid. In a form of the apparatus designed for use with pigeons (center), there is a key to peck instead of a lever to press. In either case, complex electronic equipment (right) may be used to program the schedule of reinforcement and other special conditions and to record the subjects' behavior, thus making it possible to run many subjects simultaneously.



other hand, reinforcement brings about an increase in the ability of an originally neutral stimulus to elicit an unconditioned response.

Two types of instrumental conditioning are distinguished, corresponding roughly to Pavlovian conditioning with pleasant and unpleasant unconditioned stimuli. One is called *instrumental reward conditioning*, because the response produces a stimulus which is pleasant or rewarding. The other is called *instrumental aversive conditioning*, because the response results in the withdrawal or termination of a stimulus which, if not painful, is at least uncomfortable. In the first case, the frequency of the response increases because the response obtains the reward; in the second case, the frequency of the response increases because the responder avoids or escapes from the aversive situation.

Instrumental reward conditioning. A standard situation for studying instrumental conditioning is the "Skinner box"—a soundproof box containing a small lever and a food recepta-

cle. An animal is placed in the box; when it presses the lever or pecks the key, food drops into the food tray. In more general terms, when the subject makes a response previously chosen by the experimenter as "correct," that response is immediately followed by reward, or reinforcement. On the first trial it may be several minutes before the animal happens to press the lever. On succeeding trials, however, it does so much sooner, until before long it presses the lever immediately on being placed in the apparatus.

Note that the response in instrumental conditioning is not *elicited* by a CS but rather is *emitted* by the animal "voluntarily" or "spontaneously." A subsequent event, the appearance of the food, rather than a preceding one comes to determine the occurrence and frequency of the response. It is possible to provide a sensory cue: for example, if food pellets are forthcoming only when there is a clicking sound, the animal will soon learn to press the lever when the sound is present and disregard it between such

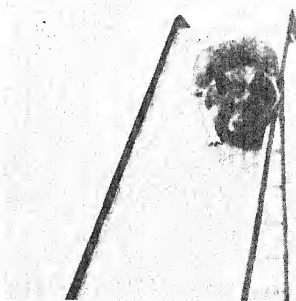
occasions. But such a cue is not essential to the establishment of an instrumental response, and the clicking sound would soon lose its effectiveness if the supply of food pellets were cut off. The two essential elements of instrumental conditioning are an instrumental response of some kind and subsequent reinforcement of this response.

A refinement of instrumental reward conditioning called *successive approximation* or *shaping* is used to train animals to make exacting performances. For example, suppose the experimenter wants to train a pigeon to peck at a circle high up on the wall of an experimental chamber. First, any motion in the right general direction would be reinforced; then motion toward the exact location, then raising the head, and so on, until the bird consistently goes directly to the right spot and pecks only at the circle. The whole process might require only about five minutes and could be extended to the teaching of more complex performances, such as turning in a circle and back again. ♦

Instrumental aversive conditioning. There are two kinds of instrumental aversive conditioning—*escape* conditioning and *avoidance* conditioning.

1. **Escape conditioning.** If on repeated occasions a metronome is sounded and four seconds later a dog's paw receives an electric shock, it is not long before the paw is flexed before the shock occurs—in response to the metronome. This is an example of classical conditioning, and the metronome has become a conditioned stimulus. In this situation the shock continues to be given. The withdrawal of the foot does not enable the animal to avoid the shock, and the flexion of the paw in response to the metronome is essentially the same as the original response to the shock.

Suppose instead that the animal is put in a Skinner box in which a shock to his paw is administered simultaneously with the onset of a metronome click, with the box wired so that he can turn off the shock by pressing the lever. In such a situation, pressing the lever is instrumental in escaping the aversive shock. The animal's own action can terminate the shock, and the sooner he makes the necessary response, the sooner he escapes from the shock. The animal will make the same immediate reflexive response to the shock but also will learn to make the instrumental response of pressing the lever. He will continue to make this instrumental re-



♦ Training animals for acts of various kinds in the entertainment world makes use of the principle of shaping behavior through rewarding gradually closer approximations to the desired sequence of responses. For example, to train a hamster to climb the ladder and slide down the slide (right), the experimenter began by reinforcing him for venturing up the ladder (left), gradually coaxing him higher and higher.

sponse as long as it is reinforced by the removal of the shock. Another example of an escape conditioning situation is afforded by an "early study" in which rats were placed in a maze filled with water. Confronted with this "sink or swim" situation, the animals soon learned to swim the maze and thus escape the water (Ruch, 1930).

2. Avoidance conditioning. If the metronome precedes the shock and the animal can avoid the shock by pressing the lever when he hears the metronome, we have an avoidance conditioning situation. Again he continues to be shocked on each trial in which he fails to make the lever-pressing response soon enough; therefore, classical conditioning of the flexion response to the metronome may take place as well as the instrumental conditioning of pressing the lever. In this situation it is important to realize that the lever-pressing response is being reinforced by its success in preventing the shock and will continue only so long as it remains successful. If conditions are changed so that shock is given on every trial whether the animal presses the lever or not, the lever-pressing response will soon be extinguished.

A dog can learn to avoid a shock presented as little as one second after presentation of a light (Finch and Culler, 1934). Other experimenters have reported similar results with a wide variety of animals.

What is the difference between instrumental (operant) and classical conditioning? Are they essentially the same, or do they involve two separate processes? Certainly they involve somewhat different procedures. In classical conditioning, two stimuli (the unconditioned stimulus and the conditioned stimulus) are presented together, and the organism learns to make a response to the conditioned stimulus that is similar to the response already elicited by the unconditioned stimulus. In other words, the conditioning procedure tends to make the two stimuli equivalent in respect to eliciting a particular response. In instrumental conditioning, on the other hand, the subject is merely placed in an experimental situation and learns to make the instrumental response that is reinforced. In instrumental conditioning, reinforcement can take place only if the correct response or an approximation to it happens to occur,

whereas in classical conditioning, reinforcement may be given on every trial regardless of what the subject does.

Extinction and maintenance of responses. As already indicated, instrumental conditioning, like classical conditioning, is subject to experimental extinction. If a rat in a Skinner box presses the lever for a long time without receiving reinforcement, his rate of response drops gradually toward zero. Once extinguished, an instrumental conditioned response, like a classical conditioned response, will show a temporary spontaneous recovery when, after an interval of time, the subject is returned to the experimental situation. With instrumental as with classical conditioning, a response learned with continuous reinforcement may be extinguished more easily than one learned with intermittent reinforcement, despite the expectation that continuous reinforcement would have established a stronger habit. This is especially likely when the extinction period involves not only extinction of the learned response but acquisition of a new one to replace it. Subjects required to reverse a habit—responding positively to black and negatively to white, for example, instead of the other way around, as previously—are able to do so more quickly if the original habit was learned with continuous reinforcement than if it was learned with intermittent reinforcement (Grosslight, Hall, and Scott, 1954).

Once learned, instrumental responses can be maintained at a high rate with only occasional reinforcement. Extensive laboratory work has gone into investigating the effects of different schedules of reinforcement on rate of response, and there are interesting parallels to these effects in everyday behavior.

When reinforcement is on a *fixed ratio* schedule, there is reinforcement regularly after a certain number of correct responses—perhaps after every sixth or tenth response. This is comparable to being paid on a piece-work basis, and in both the laboratory and the factory it leads to a steady, fairly high rate of responding. When reinforcement is on a *fixed interval* schedule—a reinforced response every two minutes, for example—responses are not very frequent during the period between reinforcements, but they begin to occur again and at an increasing rate

as the time for reinforcement nears. ■ This is comparable to studying in a course which has periodic examinations. Performing well on the examination—or avoiding a failing grade—is the reinforcer, and studying tends to be frequent only just before an examination is to be given.

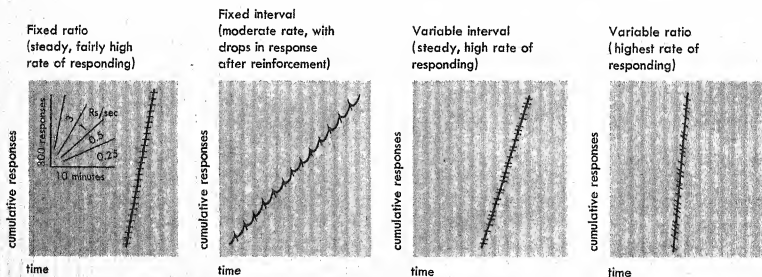
When reinforcement is on a *variable interval* schedule, the reinforcement of a correct response may be given after one minute the first time, after an interval of two minutes or longer the second time, then after a minute and a quarter, and so on, regardless of the number of correct responses made in between. The interval between reinforced responses varies each time. The subject has no way of predicting when the reinforcement will occur, and his rate of responding remains relatively constant.

The most effective schedule for maintaining a high and constant rate of responding is that of the slot machine, the *variable ratio* schedule. On this schedule reinforcement is given after a variable number of responses. The subject can-

not predict exactly when reinforcement will come, hence the constant rate. The higher the rate of responding, the more frequent the reinforcement, hence the high rate of responding.

Applications of operant techniques. Operant techniques make possible the use of animals in studying many phenomena which at one time were thought to require a verbal report and hence human subjects. An animal can be taught to press a lever or make some other observable response whenever a certain visual or auditory signal is given; thereafter it tells the experimenter by its actions whenever it perceives the signal.

One prominent use of such techniques with animals today is in the testing of new drugs. All new drugs are intensively tested with animals for both physiological and psychological effects before they are given to human subjects, and any effects on perceptual ability, learning, reaction time, or emotional arousal are carefully noted. Occasionally, however, side effects are not identified in this preliminary testing.



■ RESULTS OF DIFFERENT SCHEDULES OF REINFORCEMENT

Once established, a response may be maintained with any of several types of schedules of reinforcement, each of which yields a characteristic pattern of responding, as shown above. These patterns of response are usually recorded by cumulative curves, in which short slashes indicate the giving of reinforcement and each response takes the curve to a higher level. The steepness of the curve shows the rate of response: the more responses in a given time period, the steeper the curve. Often in the corner of a cumulative response graph there is a figure showing how many responses per second a given slope of line represents. For example, in the fixed ratio curve above, the slope of the line indicates that responses were occurring at about the rate of three per second.

A physician was treating tubercular patients with a new antibiotic. Some suspicion arose that the drug was damaging the auditory nerve. The treatment was stopped and a psychologist was called in to test the drug. By the use of operant conditioning he trained rats to respond to a tone and then identified the lower limit of their hearing ability—the safest tone they could still hear. Then he gave them doses of the drug and found that it did indeed cause a striking loss in their hearing, as shown by the fact that a much louder tone had to be sounded before they responded (Gourvitch, Hack, and Hawkins, 1960).

Operant techniques with animal subjects are being used extensively in research on brain function. Much of this research involves damage to the brain and thus could not be carried out with human subjects. The split-brain experiments discussed in Chapter 2 (p. 62) made use of operant techniques: the animals learned to make a response to stimuli presented to one eye only, with the optic chiasma cut. Their ability to make the same response to stimuli presented to the other eye indicated that there must have been communication between the two hemispheres of the brain. Their failure to make the transfer when the corpus callosum was cut identified the structure responsible for this communication between the two sides of the brain.

Another example of the study of visual pathways in monkeys through the use of operant techniques involved an attempt to identify which areas of the monkey's visual field are mapped onto which parts of his visual cortex.

Macaque monkeys were taught to put one eye up to a peephole when they heard an auditory signal and to press one lever if they saw a light, another lever if they did not. Behind the peephole was a concave surface on which there were many small light bulbs, so placed that a light could be flashed on in any portion of the animal's visual field. A tone would sound, after which one of the bulbs would flash on. As the light flashed, a photograph was made of the monkey's eye; from this it was possible to determine exactly where the monkey had been looking at the moment of the flash and hence to deduce where in his visual field the stimulus light had been. The lever he had pressed indicated whether he had seen the light.

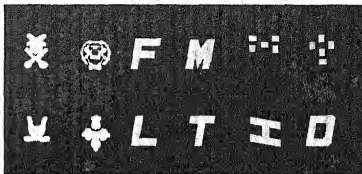
With a sufficient number of trials it was possible to construct a detailed map of each monkey's visual field. By comparing results with monkeys given lesions at different spots on the visual cortex, the exact mapping of the visual field onto the visual cortex could be studied (Cowey, 1963; Cowey and Weiskrantz, 1963).

Such research gives us invaluable knowledge for helping human beings who have blind areas in their visual fields as a result of tumors or gunshot wounds. Applications of operant techniques in other areas, such as programmed instruction and psychotherapy, will be discussed in later chapters.

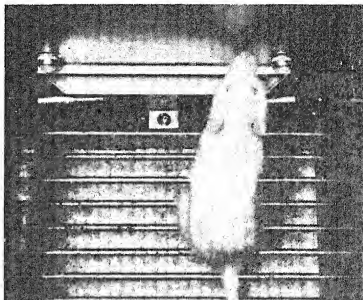
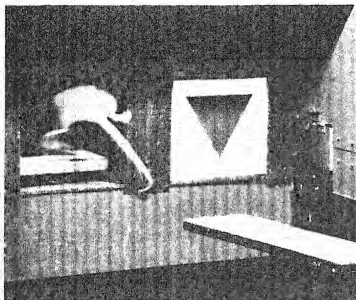
Discrimination Learning

In discrimination learning, the subject is presented with two or more stimuli which differ in some detail or with a stimulus versus no stimulus. His task is to distinguish between the two situations. He shows that he can make the distinction by responding in some prescribed way; for example, by walking to a box with some object in it rather than walking to an empty box, by saying which of two tones is higher in pitch, or by pointing to a dot of a particular hue against a background of dots of the same size but of differing hue.

Discrimination has been extensively studied in experiments using animals as subjects. When the stimuli which must be discriminated are sufficiently different, rats are able to learn to select the right one in only a few trials. The difficulty increases as the stimuli become more similar, but studies have shown that rats can distinguish remarkably small differences. A few pairs of stimuli that one experimenter has found rats can distinguish successfully are shown here (Fields, 1954):



▲ The earliest equipment for studying discrimination learning was the Lashley jumping apparatus (left), named for its creator, Dr. Karl Lashley. In this apparatus the animal is placed on a platform from which he has to learn to jump toward the correct one of two or more patterns. The wrong cards are fixed securely in place; if the animal jumps against them, he falls down into a net. If he jumps against the correct card, it falls down and admits him to a feeding platform. The positions of the cards are changed in a random way to ensure that the rat is learning to make a discrimination rather than merely to jump in a certain direction. Discrimination learning is also studied today in a Skinner box with two or more lights and perhaps a lever beneath each light (right); here, for example, the animal may have to choose the correct color of light.



Most discrimination learning studies have involved external stimuli, generally visual or auditory ones. ▲ Recently it has been demonstrated that internal stimuli, too, may be discriminated.

Five rhesus monkeys were operated upon in such a way as to isolate a segment of the small intestine by closing it at one end and attaching it to the abdominal wall at the other. An inflatable balloon was put into this intestinal loop. After the animals had been trained to press a lever for sugar pills, lever pressing was reinforced only during rhythmic inflation-deflation of the balloon. Precautions were taken to avoid giving visual cues or external stimulation. The monkeys discriminated successfully between the presence and absence of the visceral stimulation (Slucki, Adam, and Porter, 1965).

As we have seen, discrimination learning is often used in the application of operant techniques to practical problems, as in drug testing and brain research. The subject shows whether he can make the desired discrimination by

making the response that is followed by reinforcement or by failing to do so. •

Discriminations are often used also as an aid in establishing or maintaining an operant conditioned response. In this case, however, the purpose is not to see what discriminations are possible for the subject but to teach him to use a particular stimulus as a cue. Thus instead of presenting two or more stimuli at the same time and reinforcing responses toward the "correct" one, as in the jumping apparatus, the desired response—perhaps pressing a lever or pecking at a key—is reinforced in the presence of one stimulus but not another. For example, pressing the lever when a green light is on might be reinforced but pressing the lever when a red light is on or there is no light at all might go unreinforced. With continued reinforcement, the presence of the green light would soon come to control the occurrence of the lever-pressing response. The green light, in this situation, is said to become a *discriminative stimulus*, and the lever pressing is said to be

under *stimulus control*. Two conditioned responses may come to be involved here—the operant conditioned response of pressing the lever, reinforced by the subsequent appearance of food, and a classical conditioned response in which the green light becomes a conditioned stimulus, capable of calling forth the response associated with reinforcement (salivation, in this case).

Imprinting

Imprinting is a special form of learning in which hereditary mechanisms determine the time of appearance and general nature of the behavior, but the particular environmental resources at a critical time determine the specific stimulus-response connection that is learned. Its neural basis is as yet unknown. It has become increasingly apparent that the particular connection learned at this time has far-reaching consequences for the individual's later patterns of social behavior as an adult. Much of the behavior that is said to be "species-predictable" is now known to be partially dependent on the exposure of the young at a particular period in their development to certain environmental stimuli which are "normal" for that species.

The phenomenon of imprinting was first described a century ago by a British naturalist named D. A. Spalding (1873), who had noticed that newly hatched chicks follow the first moving object to which they are exposed, with a resulting unmodifiable fixation of this instinctive following response.

Lorenz (1935), the first to call this learning "imprinting," pointed out that it tends to occur only during a critical time in the social and neurological development of young animals. He also pointed to the importance of "releasers" in such learning: certain aspects of an animal's environment tend to "release" a response that is specific to that species (Lorenz, 1937). Ordinarily the parent, by visual or auditory cues or both, provides these releasers, but if adequate releasing stimuli for imprinting are displayed by a mock parent, or even an inanimate object, the infantile responses will be directed to that substitute. Thus chicks and ducklings have learned to follow human beings and even wood-

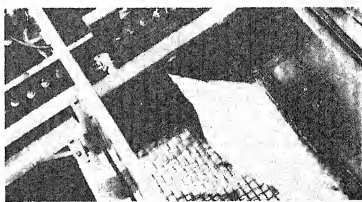
en blocks. The infant will react, however, only to the extent that the false parent-object can supply adequate releasers.

A series of experiments by E. H. Hess illustrates the experimental work being carried out in laboratories at the present time.

The apparatus consisted mainly of a circular runway around which a male mallard duck decoy could be moved. The model contained a loudspeaker and a heater. An incubator-hatched mallard duckling was taken from its box and placed on the runway; the continuous sound of a tape-recorded human "gock, gock, gock" was then turned on in the decoy model, and shortly afterwards the decoy began to move around the runway. The duckling remained in the apparatus for a prescribed length of time, usually about an hour, during which it typically made several circuits of the runway. At the end of the period it was returned to its box, where it was kept until later testing.

In the testing, the duckling was put midway between the imprinting model and a female model which differed only in coloration. Imprinting was regarded as complete if positive responses to the male decoy were given under four test conditions: (a) both models stationary and silent, (b) both models stationary and calling (the female model giving the call of a real mallard female calling her young), (c) the male model stationary and calling and the female model moving and calling, and (d) the male model stationary and silent and the female one moving and calling.

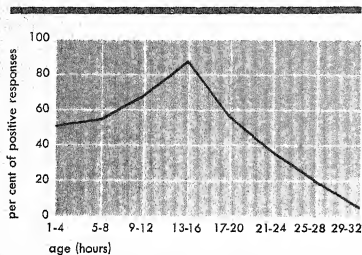
On one occasion ducklings which had been successfully imprinted to the male decoy were placed in a



● An interesting application of operant conditioning techniques is the training of pigeons as inspectors. The bird shown here, for example, can pick out defective drug capsules with a high degree of accuracy.

● IMPRINTABILITY AND AGE

This curve shows the percentage of positive responses made by groups of ducklings imprinted at different ages on test trials after imprinting sessions. Some imprinting occurred immediately after hatching and as late as thirty-two hours after hatching, but ducklings imprinted at an age of thirteen to sixteen hours consistently made the highest scores.



Based on Hess, 1959

"normal" environmental situation at the edge of a duck pond. Here they could either stay with a decoy model at the water's edge, follow a moving decoy as it swam across the pond, or go to a real mallard female who had recently hatched ducklings. The imprinted ducklings at all times avoided the live female mallard and moved closer to one of the decoys. Ducklings of the same age which had been hatched in the incubators but had not been imprinted joined the live female mallard without hesitation, ignoring the decoys.

To determine the best age for imprinting, Hess imprinted ducklings at various ages after hatching, with the results shown in the graph. ● He also investigated imprinting in older ducklings, both alone and in the presence of an already imprinted duckling. He concluded that the strength of imprinting achieved in older ducklings is less than that achieved in younger ducklings, but that social facilitation extends somewhat the critical age during which imprinting can take place (Hess, 1959).

From these and other studies Hess has postulated a critical time for imprinting bounded by the development of adequate locomotor ability at the lower end and the onset of fear at the upper end. No fear is shown by newly hatched ducklings, but locomotor ability is low. At the

maximum imprinting time, the ratio of these factors is ideal; afterwards, increase in fear is greater than increase in locomotor ability, and imprintability decreases correspondingly. In the social facilitation experiment, fear in the older ducklings was apparently reduced by the presence of the other ducklings.

The phenomenon of imprinting has been accepted by most investigators as a type of learning. Hess, too, accepts imprinting as a "rigid form of learning," and points out that it may be differentiated from discrimination learning in the following ways:

1. A long practice session with repeated trials in rapid succession (*massed practice*) is more effective with imprinting, whereas the same number of trials spaced out over a longer period (*distributed practice*) leads to faster and more stable simple discrimination learning.
2. *Primacy of experience* is most important with imprinting—the earliest experiences are those which are imprinted; recency is most effective in discrimination learning—that material presented last is remembered best.
3. *Punishment* or painful stimulation increases imprinting; in discrimination learning, reward is more effective.
4. *Tranquilizing drugs* to decrease emotionality reduce imprintability to almost zero; these drugs increase or have no effect on the learning of a discrimination problem (Hess, 1959).

Most laboratory studies of imprinting have relied heavily on the use of visual cues and have assumed that species recognition is largely a learned response to such cues. This is not necessarily the case, however.

Field studies have shown that ducklings in their natural habitat follow the mother's call even before they have had a chance to see her. Ducklings of two species were studied—mallards, which nest near the ground, and wood ducks, which nest in holes in low trees.

The initial dependence of the young on auditory cues has also been demonstrated in the laboratory. Incubator-hatched ducklings of both the above species, when placed in simulated nests, readily climbed out in response to a recorded parental call even when it was not coming from any visually perceivable object. If the call seemed to come from an object that they could see, such as a moving striped box, the response was facilitated among the mallards, which in nature see the mother

almost as soon as they hear the call. The presence of visual cues had no effect on the wood ducks, whose holes are so poorly lighted that they cannot see the mother even when she is off the nest.

In other demonstrations, ducklings without previous experience followed a model that looked like the mother and was emitting the parental call, in preference to an identical model that was emitting the call of another species. Chicks presented with both a moving but silent model of the mother and a moving recording of the maternal call coming from a totally inappropriate object or having no visible source almost invariably followed the call in preference to the model. Evidently in nature—and in the laboratory if conditions permit—the earliest parent-young bond is formed on the basis of auditory stimulation. Responses based on visual cues are more dependent on learning and do not appear until later (Gottlieb, 1965a, 1965b, 1966).

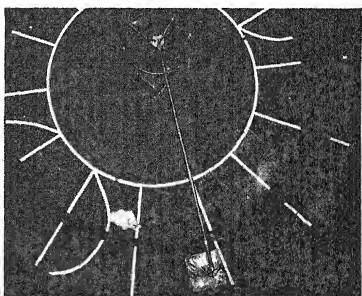
Konrad Lorenz (1935) hypothesized that the object that elicits the following response will later release related responses, such as sexual behavior. Indeed, as early as 1908 it had been found that in order to cross-breed two different species of pigeon it was necessary to rear the young of one species with members of the oth-

er species; the young birds at maturity then preferred mates of the species of their foster families (Craig, 1908).

The sad story is told of a peacock in the Schoenbrunn Zoo in Vienna whose love life was certainly influenced by its early experience.

The white peacock was the only survivor of a brood which had been exposed to extreme cold. At that time, shortly after World War I, the only environment in the zoo that was suitable for his health was the reptile house in which the giant tortoises lived. Thus his earliest impressions were of these large green friends. Later, despite repeated efforts of the zoo-keeper to interest him in the loveliest of female peacocks, the tortoises remained the only objects of his desire (Lorenz, 1952).

Most of the experimental imprinting work thus far has been performed with birds, especially ducks and chickens. It has been suggested, however, that there is a comparable critical period for the establishment of a bond between the young and its kind in most or all species where social interaction is important for survival, and that when the "normal" learning fails to take place during this interval, the social behav-



Imprinting experiments typically employ a circular runway with an apparatus by which one or more models can be moved around near the outer edge. In the example shown here, the subjects are observed in a mirror to ensure that the presence of observers will not disturb the ducklings' behavior; the markings on the floor of the circular course make possible an accurate record of distance traveled in a given amount of time. In the view at right, a duckling is following a cube that is emitting the proper maternal call.

ior of the individual is permanently impaired: if he has been imprinted to members of another species or (experimentally) to inanimate objects, or if through deprivation he has never been imprinted adequately at all, he never establishes normal relationships with members of his own kind.

Although imprinting in mammals has not yet been widely studied, the phenomenon, with its relationship to later social behavior, has been demonstrated with guinea pigs and sheep. Disruption of social and sexual behavior has also been observed in monkeys deprived of normal experiences with their kind during infancy. These latter studies will be described in Chapter 11.

Verbal Learning

(It is hardly necessary to point out the importance of verbal learning in our everyday living. There are probably few things we do in the course of a day that have not been influenced strongly by previous verbal learning.) Our ability to manipulate symbols, as in language, makes it possible for us to learn “indirectly” many responses that lower animals can learn only by doing, if at all.

Verbal learning includes any case of learning to respond to or with words. It covers a wide range of learning tasks, from that of associating two nonsense syllables to learning how to solve complex problems stated in words. For the sake of convenience, verbal problem solving and concept formation, which often includes verbal learning, will be taken up in Chapter 10 in our discussion of thinking. In this chapter we will limit our consideration to the kind of verbal learning most commonly studied in the laboratory—the memorization of verbal material presented to the subject under controlled conditions.

(The earliest such experiments were carried out by the German psychologist Hermann Ebbinghaus and involved the learning of lists of nonsense syllables like *giz*, *tak*, and *boz*. Ebbinghaus chose nonsense syllables on the theory that he would thus be studying “pure” learning, uncontaminated by any influence from meaning, emotional factors, or differing past

▲ The pattern of serial learning is being used in this memory drum experiment. The subject is being shown the word “purple”; she must respond with the next word in the series. The board mounted around the drum prevents the subject from seeing the examiner as he records her responses.



experience on the part of the learner (Ebbinghaus, 1885). Experiments in verbal learning today sometimes use nonsense syllables and sometimes use meaningful material, depending on the purpose of the experiment. Some of the ways in which meaningfulness can affect what is learned and how well it is remembered will be discussed in the next chapter.

The verbal learning studied in the laboratory has usually been verbatim memorization. Experiments typically employ a *memory drum*, which allows the experimenter to control the amount and rate of exposure of the material to be learned. ▲ One of two patterns is usually followed. In *serial learning*, the subject is shown a series of words or syllables one at a time and on successive showings must learn, as he sees each item, to call out or write down the one that is coming next before he sees it. In *paired associate learning*, the lists consist of several *pairs* of items. The pairs may appear in a different order on each trial, but the subject must learn to anticipate the second member of each pair when the first one appears. The two patterns are diagramed on the next page.

Serial Learning	Paired Associate Learning
purple ↓ banana ↓ happy ↓ run ↓ empty	purple → banana happy → run empty → round

The exact bearing of these experiments on the kinds of verbal learning that take place in the classroom is not yet clear. To the extent that classroom learning involves memorizing facts, the findings are directly applicable. But where other outcomes are sought—such as thinking critically, understanding relationships, and forming valid generalizations—the application is not so clear.

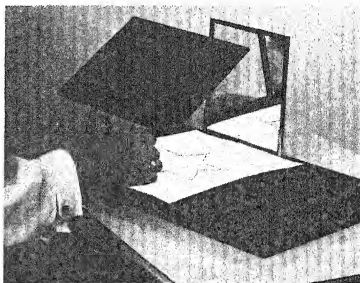
Many psychologists are of the opinion that verbal learning can be explained as a complex form of conditioning. Consider, for example, the building of vocabulary in a foreign language through the use of "flash" cards. Many students find it effective to prepare cards with the English word on one side and its foreign equivalent on the other. Such a card might say *house* on one side and *maison* on the other. Learning to say "maison" every time one sees "house" can be viewed as instrumental conditioning, in which the correct response is reinforced by the subsequent knowledge and satisfaction of being right. On the other hand, a number of psychologists hold that conditioning is inadequate to account for the learning of one's native language, since not only specific responses are involved, but also the development of generative rules (Osgood, 1963; Miller, 1965).

Motor Skill Learning

When learning involves primarily the use of the muscles, it is called *motor skill learning*. In learning motor habits the individual acquires new muscular coordinations as a mode of response to some situation. Learning to walk, to operate a typewriter, to swim, and to play baseball are everyday examples of motor learning.

Much of our verbal behavior depends upon motor learning, since the words we speak are produced by contractions of muscles located in the vocal apparatus, and the hand and arm motions we make in writing words require skilled muscular coordinations. The student who has really tried to master the pronunciation of a foreign language needs no further demonstration that talking is both a motor skill and a verbal skill. Indeed, most human behavior is produced by highly complex patterns of interacting responses of different kinds. Thus, although for purposes of clarity we distinguish motor learning from verbal and sensory discrimination learning, it is important to realize that these seldom occur in isolation. Thus psychologists investigating nonverbal learning often study animals, knowing verbal factors are not present.

Psychologists have studied a wide variety of motor-learning tasks. Many early experiments dealt with such skills as typing or telegraphic receiving, but it has been found that simpler activities with which the subject has had little or no experience are better for laboratory study. One of the most common is the task of tracing a star with a stylus or pencil when the star is seen only in a mirror. ♦ As learning pro-



♦ The subject is tracing the narrow path formed by a double star which she can see only in the mirror. The left-right coordinates are not changed by the mirror but the near-far coordinates are reversed. The mirror, being placed beyond the object, reflects in its "foreground" the parts that are actually farthest away from the subject.

■ One form of pursuit rotor. The subject is required to keep the point of a hinged stylus on a small brass target near the edge of a revolving turntable. His score is based upon the length of time he can do this.



ceeds, the tracings become progressively smoother. Quantitative changes can be measured by plotting the number of errors made on each trial or by recording the time required to trace the star on successive trials.

Another apparatus widely used in studies of motor learning is the *pursuit rotor*. This device consists of a revolving turntable in which is imbedded a small metal target. The subject's task is keeping the point of a hinged metal stylus in contact with the moving target; loss of contact breaks an electrical circuit. ■

Mixed Learning Tasks

Many learning tasks involve two or more of the above types of learning. Good examples of such complex tasks are the various kinds of mazes, which have been used with both animal and human subjects. Mazes call for sensory discrimination, motor learning, and sometimes,

with human subjects, the use of verbal cues. Two types of mazes used with animals and one designed for use with human subjects are shown in the illustration. ■

Attitude Learning

Much of our learning, in and out of school, involves changes in our attitudes—our disposition to give favorable or unfavorable responses to objects, persons, situations, or abstract ideas. We can define an *attitude* as a relatively stable, learned, emotionalized predisposition to respond in some consistent way toward one or a group of objects, persons, or situations.

Just as verbal, sensory discrimination, and motor learning occur together in varying combinations, so attitude learning is found in most life experiences. We learn attitudes toward school as we study mathematics or history; we learn attitudes toward tennis as we practice our forehand drive. Tendencies to be prejudiced or tolerant, selfish or generous, cooperative or antagonistic all reflect attitudes learned through previous experiences.

Laboratory studies give evidence that attitudes can be changed according to the principles of conditioning. For example, nonsense syllables will be regarded positively or negatively depending on whether they have been associated with the names of history's heroes or villains.

One study used names rated most positively or most negatively by two hundred college students. Eighteen positive names and eighteen negative names were used. Among the positive names were Winston Churchill, Abraham Lincoln, and Helen Keller, while the negative ones included Jimmy Hoffa, Adolf Hitler, and Benedict Arnold. In one experimental group, the nonsense syllable YOF was paired with positive names and the syllable XEH with negative ones, the reverse holding true for another experimental group.

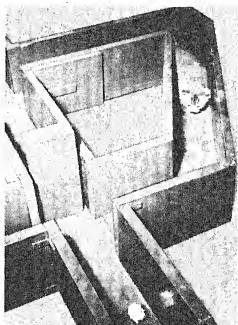
In both groups, highly significant differences occurred in the subjects' ratings of the syllables at the end of the conditioning trials, indicating a strong conditioning effect. Women students were more extreme in their ratings, both positive and negative, than were males. In a manner of speaking the syllables acquired "guilt (or grace) by association." (Blandford and Sampson, 1964)

Here attitudes already present were related to previously neutral stimuli, the nonsense syllables, through classical conditioning. The same thing can happen even to stimuli not neutral to begin with, such as the names of different nationalities, toward whom most of us have attitudes of some kind, based on previous experience and evidence.

In one experiment, students in introductory psychology classes were shown six national names—German, Swedish, Italian, French, Dutch, and Greek. The names were shown for five seconds and in random order. One second after each appeared on the screen, an unconditioned stimulus word was pronounced by the experimenter; these included pleasant words like *gift*, *sacred*, and *happy*, negative words like *bitter*, *ugly*, and *failure*, and neutral words. The UCS words were presented eighteen times in random order. The word *Dutch* was always given with words that had positive meanings, whereas the word *Swedish* was always paired with negative words. The other names were accompanied by neutral words.

Another group of students went through a similar procedure except that Swedish was paired with pleasant words and Dutch with negative ones. At the beginning of the experiment, and again at the end, the subjects rated the six national names on a scale of pleasant to unpleasant. Even though many subjects could not remember what kinds of words the names had been paired with, there was a clear shift in their attitudes toward Swedish and Dutch corresponding to the tone of the words that were paired with them (Staats and Staats, 1958).

Attitude learning in real-life situations is, of course, heavily influenced by a great many factors other than the particular stimulus being presented at a given moment. The learning of attitudes begins early in childhood, and is shaped to a large extent by parental influences and other social factors. Personality factors, such as the individual's goals and his self-concept, also enter in. The formation of attitudes will be explored in greater detail in Chapter 16.



● TYPES OF MAZES

In a straight-alley maze (left), there is no choice point; records are kept of the latency of the response (how long it takes the subject to leave the starting box) and his speed of running to the goal box at the far end. Mazes with choice points may have a simple choice of left or right at the end of a runway or may, as shown here (center) have pathways of various shapes with one or more choices required. With human subjects a recessed multiple T pattern is often used (right); the blindfolded subject traverses the maze with his finger or a stylus.

Psychologists have long assumed that structural changes of some kind must occur in the organism's central nervous system during learning. Only recently, however, has evidence become available as to what these changes may be and where they may occur.

Chemical Coding: Breakthrough or Interesting Speculation?

For some time psychologists have suspected that the cellular material ribonucleic acid (RNA) is involved in the memory of learned acts. Since the structure of an RNA molecule is similar to that of the DNA molecule, which, as we have seen, encodes genetic information, psychologists have hypothesized that the RNA molecule might encode memory traces as the genetic molecule does hereditary traits. Two recent studies lend support to this hypothesis.

Rats were trained to approach a food cup when a click was sounded. RNA was extracted from their brains and injected into the bellies of untrained rats. The untrained animals thereafter had some tendency to go to the food cup when the click was heard (Babich, Jacobson, Bubash, and Jacobson, 1965).

In a second experiment one group of rats was trained to respond to a click, another to a light. RNA from the two groups was injected into untrained rats. On the average, the "click-injected" rats oriented somewhat more to click than to light and the "light-injected" rats responded somewhat more to light than to click, though neither group showed a clear tendency to respond to either stimulus. The "injected memory" took a few hours to take effect and faded gradually in an untrained animal unless reinforced by training (Jacobson, Babich, Bubash, and Jacobson, 1965).

Findings like these raise the possibility that chemical change is one aspect of learning. Unfortunately, other careful workers have not been able to duplicate them (Gross and Carey,

1965). In one follow-up study, a radioactive tracer established the fact that the injected RNA did not reach the brains of the animals studied (Lutttges, Johnson, Buck, Holland, and McGaugh, 1966).

In the early stages of a new type of research, it is not unusual for controversy to be generated by apparently contradictory findings. Further research is needed to identify all the necessary and dependent variables; only as these become known is it possible to formulate an adequate theory.

It has been found that blocking the protein synthesis carried out by RNA may eliminate recent memories in mice (Flexner, Flexner, and Stellar, 1963). Whether or not RNA actually encodes past memories (and whether, if so, such memories can be transferred to another organism), there is some preliminary evidence to suggest that an increase in the production of RNA may be accompanied by improved performance of a learned task. In one study, rats given the drug magnesium pemoline, which increases the production of RNA, learned instrumental responses five times as fast as untreated rats (Plotkinoff, 1966). It is still possible, however, that the pemoline improved performance because it is a stimulant rather than because it increased RNA production.

Where Does Learning Take Place in the Brain?

Where is memory stored? Today we are nearer to an answer to this question of "where" than to the one of "how" which we have just left.

Not until the 1930's were surgical and other techniques adequate to begin to identify the structures that take part in learning. The first steps in this analysis proceeded by the "is-ain't" practice of the analytical chemist. One of the first questions asked was whether the spinal cord itself with no help from the brain was sufficient for learning—whether learning could

take place if connections with the brain were severed so that only the spinal cord and peripheral nerves were involved. Studies gave some evidence of conditioning under these conditions, but the spinal cord was not found to be capable of carrying out a true conditioned reflex (Forbes and Mahan, 1963).

The next question was whether the subcortical areas of the mammalian brain were sufficient for learning. As we saw in Chapter 2, some learning ability was evidenced in animals deprived of all cerebral cortex, but responses were slowly acquired and were gross, involving only widespread thrashing types of movement (Culler and Mettler, 1934).

Clearly in dogs, and presumably in animals above them on the phylogenetic scale, the cerebral cortex was essential for precise learning. But did this necessarily mean that subcortical structures played no role at all? A more plausible formulation was that the cortex is important for fine discrimination of sensory input and minute adjustment of motor output but that subcortical structures provide the switchboard effect—which is a minimum requirement of simple CR learning. (That the same thing is not true for all species is clear since the pigeon, which has little true cortex, and the fish, which has none at all, can learn to discriminate between visual stimuli and respond rapidly and well.) In higher animals and man, with their ample supply of true cortex, it is becoming increasingly clear that a number of subcortical structures contribute substantially to the execution of learned acts. There is good evidence that one subcortical structure, the *hippocampus*, is crucial for recent memory.

The problem of the exact role of different parts of the cortex remained. An earlier investigator, using instrumental conditioning and ablation techniques, had reached a conclusion then unacceptable: that a learned connection was not localized in any one place. In fact, he had demonstrated that a learned response did not depend on any simple cross connection between sensory and motor areas (Lashley, 1929, 1950). In later work with monkeys it was found that cutting the connections between visual and motor areas or cross hatching the brain with cuts so as to sever many connections did not end effective eye-hand coordination or previous-

ly learned visual responses. The same was true for lesions in the association area surrounding the primary visual area (Sperry, 1947).

It now seems clear that in some manner not yet understood a large expanse of the cerebral cortex—together with its connections to other parts of the brain—is involved in the learning of even a very specific response. For example, even though you have always written with your right hand, involving, presumably, action of the left hemisphere of your brain, your past learning would enable you to write your name with your left hand (however clumsily). Similarly, if you learn to distinguish between two objects with one hand by feel, you can immediately do so with the other hand.

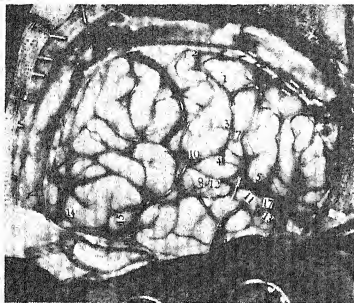
It has also been discovered that some types of sensory and motor learning involve not only the sensory and motor areas, but also areas located elsewhere in the cortex. For example, the temporal lobe is traditionally associated with hearing, but if a part of the temporal area is destroyed after the learning of a visual discrimination, the learned visual response is lost.

An especially dramatic discovery has been the finding that stimulation of the temporal lobe of conscious patients during brain surgery, as pictured on page 202, produces a flashback type of memory, with well-formed visual and auditory experience (Penfield, 1958). One patient stimulated in this way saw an orchestra, heard the specific piece of music, and even felt the emotion that he had experienced years earlier on the occasion being recalled. Evidently this part of the brain is concerned with integrating the responses of brain regions considerably remote from it.

All in all, it seems apparent that simple, reflex-like connections are not adequate to explain the observed facts, and we no longer expect to find a simple connection between a conditioned stimulus and an unconditioned response exclusively at one particular spot in the brain.

Another indication of wide involvement rather than reflex or S-R activity in the cerebral cortex is the role of the most frontal part of the cerebral cortex in the kind of behavior called for in delayed-reaction experiments. In the laboratory a monkey or chimpanzee is shown two cups and watches the experimenter put food in one of them. Both cups are then covered and

This is the right cerebral cortex of an epileptic patient. It has been exposed for surgery with the patient fully conscious. The numbers indicate spots at which electrical stimulation produced positive responses—simple sensory and motor responses at spots 2, 3, 7, 4, and 8 and flash-back experiences at spots 11, 12, 15, and 14. For example, when spot 11 was stimulated the first time, she said "I heard something familiar, I do not know what it was." When the stimulation was repeated without warning, she said, "Yes, Sir, I think I heard a mother calling her little boy somewhere. It seems to be something that happened years ago." When asked to explain, she said, "It was somebody in the neighborhood where I live." She added that it seemed that she herself "was somewhere close enough to hear." (Penfield, 1958, p. 28)



the subject's vision is blocked with a screen for an interval, after which he is allowed to reach and eat the food if he knows where it was placed. With short intervals, he has no difficulty, but as the interval is lengthened a point is reached where the task becomes too difficult for him. Some investigators have used this as a measure of what is operationally termed "immediate memory."

In monkeys and animals as close to man as the chimpanzee, ablation of the prefrontal lobes virtually abolishes the ability to select the right cup (Jacobsen, 1936). Here, then, is another part of the brain quite remote from areas directly serving sensory or motor functions that is vital to the performance of complex learned responses. Investigators differ as to

whether the function of the frontal lobe is that of short-term memory storage or perseveration of a process that has been initiated (Warren and Akert, 1964).

These various findings suggest that the picture of stored memories as individual synaptic connections is too simple. It seems evident that the effects of learning may be transferred from one region to another and may be stored in a number of places.

Mechanisms of Memory Storage

Investigators speak of an *engram* or *memory trace* as that which occurs in the brain when learning has taken place. Interestingly, however, it has been found that *engram formation* does not ensure long-term *engram storage*. The process by which information is temporarily held as it is being acquired is evidently quite different from the process by which it is permanently stored in the brain (Hebb, 1949).¹

Experiments confirm this "two-process" theory of memory. The first process, the formation of the engram and its temporary storage, occurs during the learning trial; it lasts only for a brief period, however, and the engram is lost unless the second process occurs, in which the memory trace is permanently stored. The hypothetical process by which the fragile and unsustained "recent memory" process is converted to a long-lasting memory storage is termed *consolidation*. Experiments such as the following have demonstrated the separate action of the two processes.

Animals were trained to leave a starting box to avoid a mild shock to the feet. Only one trial per day was given, and each trial was followed at some interval from a few seconds to several hours with an electric shock through the brain, strong enough to cause a seizure. During such a seizure many of the nerve cells of the brain are thrown into a temporary chaotic discharge. The development of the habit was not interfered with in the least if sufficient time (one hour) separated the trial and the brain shock. When the seizure followed the trial in less than one minute, however, there was

1. A detailed discussion of the processes involved in memory storage will be found in the article by James L. McCaugh in Reference Manual Section B.

very little recall of the avoidance training on subsequent trials. In these latter cases whatever was learned about avoiding the mild shock during the initial daily trials was evidently prevented from being stored permanently (Duncan, 1949).

That the effect was truly due to prevention of consolidation, and not just to a general disruption of behavior, has been demonstrated by other experimenters.

Two separate studies produced the same results. In each, a thirsty rat learned to run through an alley to reach water. Then, on a single trial, a strong shock was administered to his foot, suppressing the alley running behavior. This was followed by a strong shock to the brain. It was reasoned that if the shock to the head interfered with a consolidation process the rat would not remember the foot shock the next time he was put in the maze, and thus would show no avoidance behavior. If fear of the head shock was a factor, however, the rat could be expected to show pronounced avoidance behavior. No avoidance behavior took place in either study, indicating that memory of the foot shock had not been stored and confirming Duncan's interpretation (Heriot and Coleman, 1962; King, 1965).

A two-stage memory process also seems needed to explain the clinical phenomenon known as *retrograde amnesia*. It has long been known that a blow to the head or an electroshock convulsion will cause a person to forget

the events which occurred a few seconds or minutes before the trauma, although his more permanent memories are not impaired.

Studies of consolidation prove only that it occurs, not what it is. However, discovering where in the nervous system something occurs and establishing its duration gives us major clues toward identifying the actual mechanisms. It is possible that consolidation may be a matter of permanent changes in synaptic transmission, perhaps involving RNA, whereas the immediate memory trace may concern only short-lived electrical phenomena. The self-exciting circuits described in Chapter 2 come to mind as a possible basis for this short-term memory trace. Repeated afferent stimulation also leaves a motoneuron hyperexcitable long after the stimulation has ceased, and changes in synaptic events have been observed to last as long as an hour after the end of stimulation.

So there is, as yet, no definitive understanding of the neural basis of either long-term or recent memory, although we can demonstrate by behavioral experiments that these two types of memory process exist. Fortunately, improved techniques for the molecular analysis of the brain are now available—such as, for example, the electron microscope. Whenever it may be achieved, scientists who study the brain have no doubt that an explanation of memory, and thus of learning itself, will be made in electrochemical terms.

MEASURING LEARNING

Despite the amount of research devoted to the learning process, we do not know exactly what physiological events underlie the behavioral changes that we see. Yet these changes obviously do occur, and they can be observed and measured.

If such observations are to be of any worth, however, it is necessary first to define precisely the behavior that will be taken as a criterion of learning—as a dependable sign that learning

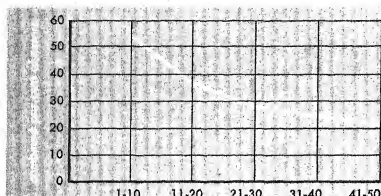
has occurred—and second to design procedures for measuring different amounts of this criterion behavior.

Criteria of Learning

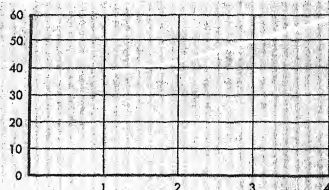
It is fairly easy to set up a criterion of learning in conditioning experiments—perhaps blinking a certain number of times or pressing a

ACCURACY AS A CRITERION OF LEARNING

The graph on the left shows the decreasing errors of twenty macaque monkeys in learning which of two stimulus objects to displace in order to obtain a food reward. The objects were wooden figures, and the choice was between a blue cross and a yellow circle, or between a black square and a red triangle. The graph on the right shows the increase in per cent of correct responses of a group of rats in a discrimination situation over a period of four days.



Based on Warren and Brookshire, 1959



Based on Lechner, 1961

lever with a certain frequency. Even with verbal learning a criterion of learning is easy to specify if the task is something specific like mastering a list of spelling words: one simply counts the number of words spelled correctly before and after practice. It is much more difficult, however, to find a dependable and measurable criterion when one wants to find out if, as a result of certain classroom experiences, students have learned to carry more responsibility, to be more cooperative, or to think more critically. Much current educational research is concerned with defining and establishing "criterion behaviors" that will give a better indication of such learning outcomes than the traditional paper and pencil tests or recitations have given.

In laboratory studies of learning, the criteria most often used as indications of learning are: (1) accuracy of response, (2) speed of response, (3) strength of response, (4) probability of response, (5) effort in response, (6) resistance to extinction, and (7) resistance to interference.

Accuracy of response. In laboratory learning experiments the subject, whether human or animal, is usually given a task in which his re-

sponses can be scored as right or wrong. A record can then be made of either his errors or his correct responses (or both) on each trial. In most learning, many errors and unnecessary movements are made in the early stages, but as practice proceeds, errors tend to be eliminated or reduced. The increased accuracy is taken as an indication that learning is occurring. If errors are plotted, the curve goes down during learning. If correct responses are plotted, it rises.

It is possible, however, to arrange the conditions of learning in such a manner that no errors will occur. This can be done with human subjects through the use of a relatively new technique called programed instruction, which will be described in Chapter 7.

Pigeons, too, can be trained to discriminate between colors without making any errors if discrimination training begins early before much conditioning has occurred in the presence of the reinforced ("correct") stimulus and if in the beginning the two stimuli differ markedly in brightness and duration, as well as wave length (huc). As training proceeds, the brightness and duration of the unreinforced ("incorrect") stimulus are gradually changed

until they are the same as those of the reinforced stimulus and the two stimuli thus differ only in wave length. In a study in which some birds were trained in this manner and others were trained under conditions in which errors did occur, only the latter showed "emotional" responses in the presence of the unreinforced stimulus (Terrace, 1963).

Speed of response. As errors and unnecessary movements are eliminated, the time required to make the correct responses decreases. Speed of response, as a criterion of learning, may be measured either by noting the decrease in the amount of time required to perform a response or by recording the increase in the number of responses made in a given amount of time.

Strength of response. In classical conditioning the experimenter often makes a quantitative measurement of some physiological activity (such as the number of drops of saliva or the amplitude of the galvanic skin response) which occurs in response to the conditioned stimulus. As conditioning advances, the measured strength of the response increases.

Probability of response. As learning continues, the probability increases that the learner will make the correct response rather than an unrelated one. This criterion is difficult to measure for only one subject, but when a group of subjects is used, probability of response can be measured according to the percentage of the group making an adequate response on each succeeding trial (Estes, 1957). Percentage figures were plotted in the two graphs on page 204.

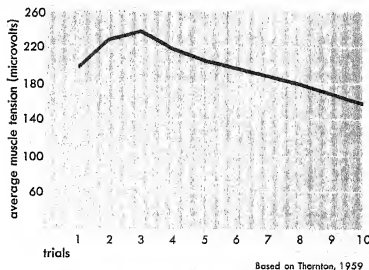
Effort in response. When we begin to learn a complex skill, we are often painfully conscious of each detail of the act to be learned and are aware of putting forth a great deal of effort. As learning progresses, we become less aware of the details and feel less effort and strain.

A feeling of effort is such a subjective criterion that it is seldom used in learning experimentation, but sometimes it is possible to get objective measures of the decreased energy output as learning proceeds. In some studies, for example, energy cost has been gauged by the

amount of carbon dioxide the subject exhales (Becker and Olsen, 1914; Rounds, Schubert, and Poffenberger, 1932). Energy cost is not often used as an indication of learning progress because of the complexity of the apparatus required to make the physiological measurement.

Muscle tension is a more frequently used measure of effort, especially in motor learning. Muscle tension increases during the first few trials and then decreases (Thornton, 1959).

Resistance to extinction. It was formerly reasoned that the better established a learned response was the more resistant it would be to extinction and hence that resistance to extinction could be used as a measure of the strength of the learned response, or habit. It is now recognized, however, that the rate of extinction depends on several other factors in addition to habit strength. For example, if a response is learned, and the subject is then required to learn to choose the formerly wrong alternative, the rate at which the first response is extinguished is influenced both by the schedule of reinforcement on which the first response was



DECREASE IN MUSCLE TENSION AS A CRITERION OF LEARNING

This curve, showing the change in muscle tension for one experimental group in a perceptual-motor task, illustrates the typical pattern. The electrical output of the working muscles was measured by using cellulose sponge electrodes connected to amplifying and recording equipment.

learned and maintained and by the strength of the new reinforcing stimulus (Theios and Blosser, 1965).

It sometimes turns out that what is happening during so-called "extinction" is not a breaking down of the original response but a new, parallel learning: when the original learning conditions are reinstated (reward present), the original learned response often turns out to be as strong as ever (Bunch, 1963). In such cases the subject has evidently retained the response in his repertoire but has learned not to make it under conditions of no reward. In some cases, too, the persistence of a conditioned response during extinction trials may be simply the result of an unclear stimulus situation in which the extinction conditions are not perceived as being different from the learning conditions (as when partial reinforcement has been used). When this is the case, resistance to extinction may be more related to the perceptual situation than to the strength of the learned response.

Resistance to interference. The better a response has been learned, the less it will suffer when a conflicting response must be learned; and, conversely, the less well it has been learned, the more vulnerable it will be to such interference. But interference may also indicate lack of perceptual clarity. Thus presence or absence of interference may be simply an indication of whether the subject is able to distinguish between the old and new stimulus conditions, each of which he associates with an appropriate response. Therefore, interference or resistance to it does not necessarily prove anything about the strength of the learned response and, used alone, is not a dependable measure of the degree of previous learning.

Of the above seven methods of measuring the amount of learning that has taken place, the ones most frequently employed are accuracy, speed, strength, and probability of response. These are easiest to work with in the laboratory as well as in ordinary life situations.

Learning Curves

Whatever criteria of learning he uses, the experimenter can get a clearer picture of how

learning has progressed by plotting his data in a *learning curve*. Several examples of learning curves have been shown in the last few pages. They are graphic devices for showing the quantity or quality of a subject's performance after successive units of practice. The unit of practice may be a single trial, a block of trials, or an interval of time. Units of practice are customarily shown along the base line of the graph; amounts of the criterion behavior are shown along the vertical axis.

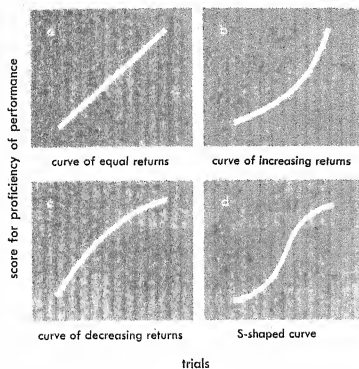
Learning curves display a variety of shapes, depending on the behavior being learned, the criterion employed to measure learning, and the amount of learning that was still possible at the start of the experiment. In interpreting learning curves it is important to note the particular aspect of performance being recorded and the subject's initial proficiency.

Usually an experimenter wants to determine not only the general *direction* of a curve, but also the *rate* at which performance is changed. Curves showing four different types of learning rates have been found: curves of equal returns (linear acceleration), curves of increasing returns (positive acceleration), curves of decreasing returns (negative acceleration), and S-shaped curves. •

Curves of equal returns. Some learning experiments yield curves of *equal returns*. These "curves" are essentially straight lines; they indicate that each trial has yielded the same amount of improvement. Obviously a curve of equal returns could not continue indefinitely, for this would indicate that there was no limit to the effectiveness of practice and no ceiling to learning capacity. Thus a curve of equal returns is seldom obtained over a large number of trials. The curve of the Lachman study on page 204 is a curve of equal returns.

Curves of increasing returns. Sometimes, especially at the beginning of learning, each trial brings more improvement than the one before it. But this happens only over a short period. Curves of *increasing returns* from practice are rare. If the returns actually continued to increase with each trial, the learning curve would soon be shooting almost straight up, a trend that could not go on indefinitely.

COMMON FORMS OF LEARNING CURVES



Curves of decreasing returns. Most laboratory studies of learning performance yield curves of *decreasing returns*. Such a curve indicates that the greatest amount of improvement occurred during the early trials. This diminishing of returns on subsequent trials continues until a point is reached beyond which practice brings no further improvement. The curve then levels off, indicating that the subject's top level of performance has been reached.

S-shaped curves. The fact that different experimental studies yield curves of different shapes does not necessarily mean that there are different kinds of learning which follow different trends. A more likely explanation is that different curves are found because few experiments show the *entire* learning process. In the early stages of learning a completely new and unfamiliar skill, a subject is likely to show increasing returns from practice, because there is a great deal of room for improvement. If the task is one with which the subject is already partially familiar, on the other hand, practice is likely to yield diminishing returns—the person who is already on the way to “perfection” has less distance to cover than the person who is

starting at the beginning. There are few laboratory tasks so new to the learner as not to be able to utilize some previous learning. But if subjects are presented with such a task and if it is of equal difficulty throughout, a record of their progress from beginning to end can be expected to yield an *S-shaped* curve. This curve incorporates all three of the curves described above. At first, the learning rate increases with each trial, giving a curve of increasing returns. Then, for a time, the rate of learning remains constant, yielding a section of the curve which shows equal returns. Finally, there is a tapering off: less improvement is shown on each successive trial and the curve becomes one of diminishing returns, tending to level off entirely at the end. Such an S-shaped curve probably represents the complete course of learning.

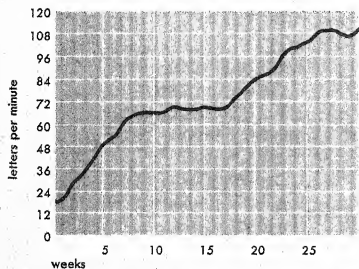
Fluctuations from trial to trial. Although learning curves show a generally consistent improvement in the subject's performance, there is usually some variability from trial to trial; on some trials performance even becomes slightly worse. Does this mean that learning itself is proceeding irregularly, or even that the subject is “losing ground” on some trials? A more likely explanation is that the fluctuations are partly and perhaps wholly the result of such factors as fatigue and fluctuations in attention. Since a learning curve for one person generally shows fluctuations, it is usual to combine the performance records of many subjects into one curve, letting these random errors balance each other out.

Plateaus. Learning curves for some types of skills frequently have *plateaus*, or flat places. During the period of a plateau there is no *apparent* improvement. Whether this indicates an actual arrest in the learning process itself is undetermined. Three possible explanations of plateaus have been suggested:

1. A plateau may be caused by loss of interest. Under conditions of boredom, there may be actual decreases rather than increases in performance with continued practice. After a short period of no practice or of a different activity, the subject may return to the original task with renewed vigor.

2. A plateau may reflect a change in the subject's mode of attack on the problem. A person who is learning to type, for example, may display considerable initial improvement in performance by employing the "hunt and peck" method. But suppose that in order to increase his efficiency, he begins to try the "touch" method. When he first makes the transition, he may show no apparent improvement or may even appear to lose ground. Finally, however, when he acquires the higher-level habit, he forges ahead again.

3. A plateau may result from interference. A different skill learned previously can hinder the learning of the new one, and sometimes parts of the same task interfere with each other. It is well known, for example, that too much practice in reading aloud will interfere with progress in learning to read silently. The most common source of plateaus due to interference is "forced feeding." When the teacher or textbook intro-



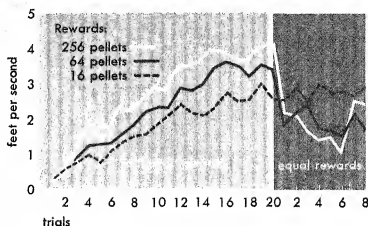
Based on Bryan and Harter, 1899

▲ PERFORMANCE CURVE SHOWING A PLATEAU

This curve shows the progress of an apprentice operator learning to receive connected discourse in telegraphic code. This experiment, performed in 1899, was one of the classic experiments in psychology. By systematically plotting the course of learning of a complex perceptual-motor skill for the first time, it opened the way for much additional research, and by demonstrating that psychological processes could be studied systematically, it helped gain acceptance for the new science of psychology.

◆ LEARNING VS. PERFORMANCE

In a classic study three groups of rats learned to run down a pathway to get food pellets from a box at the end. At first, one group received 16 pellets, another 64, and the third 256. During these early trials, speed of running was directly proportional to amount of reward. On later trials, all groups received only 16 pellets. The performance of the second and third groups dropped off sharply, and soon the running speeds of the three groups were reversed. This indicates that the earlier curves had reflected differences in motivation rather than differences in amount of learning.



Based on Crespi, 1942

duces new skills or concepts too rapidly, the learner does not have sufficient time to gain a functional mastery of each. The result is a plateau, which continues until the individual is able to assimilate each new element.

In the learning experiment illustrated in the graph at left, there is a period of little progress beginning at about the thirteenth week of practice. This is a typical plateau. Then, after the nineteenth week, the learning curve shoots up rapidly again, showing new improvement in performance (Bryan and Harter, 1899).

Many curves show no plateaus. In one study of the learning of telegraphy, none of the 43 subjects exhibited a prolonged plateau (Reed and Zinszer, 1943). The occurrence or nonoccurrence of plateaus seems to depend upon the nature of the task, the motivation of the learner, the manner in which he approaches the task, and the amount of previous experience he has had (Keller, 1958).

Changes in performance with changes in motivation. As we have seen, learning can be inferred when performance improves with practice. This does not necessarily mean, however, that a steeply rising curve under high reward indicates more learning than does the more slowly rising curve that is obtained with less reward. • Nor does it mean that we can infer *lack* of learning when performance *fails* to improve. Numerous experiments have shown, for example, that when rats are allowed to explore a maze with no food reward, they continue their variable behavior until food reward appears, at which time they suddenly start going quickly and unerringly to the goal box which contains it. If the food reward is then placed elsewhere in the maze, they start running quickly and without errors to the new spot as soon as they discover it. The usual gradual curve of error elimination is not seen in either case. One possible explanation is that learning occurred during the free exploration period through action of the curiosity drive (see Chapter 11), with exploration itself as the reward, but was not reflected in performance until the food reward was introduced at a specific place. Another explanation makes no assumptions about curiosity or other drives which may be involved, but regards learning as having occurred in the absence of reward. No "critical experiment" has yet been performed to investigate this important issue.

The physiological limit. Even though an individual learns with the most efficient possible mode of attack on his problem, works

under the best conditions of motivation, and practices tirelessly, his performance in any motor task eventually reaches a point beyond which further practice brings no further improvement. In mathematics the upper level approached by such a curve is called an *asymptote*; when the curve has nearly reached that level, it is called *asymptotic*. This point is also called the *physiological limit*, since it is determined by the speed and coordination with which nerves will conduct and muscles contract. A striking example of the physiological limit is provided by performance on the hundred-yard dash. Given the best coaching possible and the utmost in desire to achieve, few runners have been able to run a hundred yards in less than nine and a half seconds and none in as little as nine seconds. Similarly, few men can run a mile in less than four minutes and none has ever done so in three and one half minutes. The physiological limit looks like a plateau but is not followed by a further rise in the curve.

Investigators have not yet found a physiological limit in the learning of such things as mathematics, physics, chemistry, or chess. In blind-fold chess, for example, it was once considered remarkable for a player to be able to play three or four games at a time. Now a master can learn to play thirty or forty at one time. In such areas of activity it may even be that further learning becomes *easier* as we gain knowledge. When the subject matter is rich enough or the game complex enough in its strategy, a highly intelligent person can probably continue to learn indefinitely.

MEASURING RETENTION AND FORGETTING

Retention and forgetting, like learning, cannot be observed directly but must be inferred from the subject's performance. To gauge the retention of a learned response, at least two measures of performance are required—the first

taken immediately after practice is terminated, the second after an interval of time. The difference between the two measures tells us how much has been lost during the interval. There are three commonly used methods of

measuring retention—recall, recognition, and relearning.

The Method of Recall

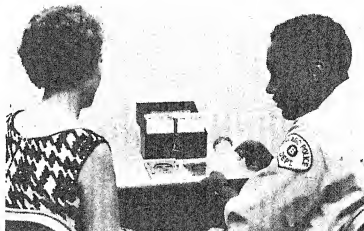
The most widely used method of measuring retention is the method of recall: the subject is required to make some response that he has learned previously. This method is familiar to the student, who is often required to recall in an examination material that has been assigned for study. For example, if he has learned the capitals of the fifty states but can remember only thirty-six of them on a test, his recall score can be stated as 72 per cent. Such a figure does not have precise mathematical significance, however, for we cannot say that a score of 72 per cent would indicate twice as much learning as one of 36 per cent, or that no recall at all would indicate complete forgetting. Other methods of measuring retention are more sensitive indicators of memory than the method of recall, and it is often possible to detect retention by these other techniques even when recall yields a score of zero.

The Method of Recognition

When the retention is measured by the method of recognition, the subject does not try to recall the items he has learned. Rather, he is given a list containing these items interspersed among new ones and is asked to identify those that were in the original list. He is graded on the percentage of items he recognizes correctly, beyond the percentage he might be expected to get right through pure chance by guessing. The same student who scored only 72 per cent on a recall test of the state capitals might well make a perfect score on a test of this type. Multiple-choice examinations test retention by use of the recognition method.

Two variations of this method are frequently used by the police in the identification of suspected criminals. In one, the suspect is put with persons known to be innocent, and the witness is instructed to identify the criminal. In this application of the method, it is important that the chance element be very slight. This

■ This witness is helping the police officer to make up a composite picture of the suspect.



can be ensured by having the line-up consist of a large number of people, most of whom look enough like the suspect that he does not stand out as the obvious culprit. In the second variation of the method, the witness is asked to select the features most like those of the criminal from a series of pictures of noses, heads of hair, foreheads, chins, eyes, and other features. From his selections a very accurate picture can be obtained. ■

The method of recognition almost always yields a numerically higher score than that of recall. We can recognize many items that we cannot recall unaided. Everyone has had the experience of trying to recall a name and failing utterly until somebody suggested several names, one of which was immediately recognized as correct.

The Method of Relearning

The method of relearning is the most sensitive of all measures of retention. Here the subject relearns the original task under the original conditions. A record is kept of the number of errors made, the number of trials needed, or the time required for the subject to relearn the task to the original degree of mastery. The subject's retention score is the difference between the amount of practice required for the original learning and that required for relearning. This difference is called the *absolute savings score*.

Sometimes the savings score is given as a percentage of the original learning score—the *relative savings score*. The method of relearning will often reveal some effects of prior learning even when conscious memory is completely absent.

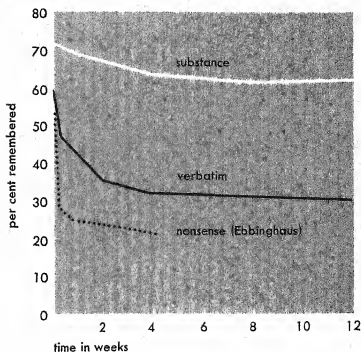
The Course of Forgetting

Some of the earliest research in psychology was devoted to plotting the "curve of forgetting." As we might expect, the findings in most cases indicated that forgetting does not proceed at a steady rate but seems to be most rapid immediately after the end of the learning period. As time goes on, the remaining knowledge becomes more and more stable.

Retention of verbatim learning. Most of what we forget is forgotten soon after it has been learned. This fundamental fact was first discovered by Ebbinghaus and has been verified repeatedly (Ebbinghaus, 1885; Cain and Willey, 1939).

Ebbinghaus learned twelve lists of thirteen nonsense syllables each until he could recite them twice without error. After twenty minutes had passed, he again studied the lists until he could repeat them perfectly twice. The time saved in relearning was 56 per cent of the original learning time. Varying the lists and the amount of time between learning sessions, Ebbinghaus constructed a curve of retention on the basis of his data. • Note

▲ RETENTION OF IDEAS

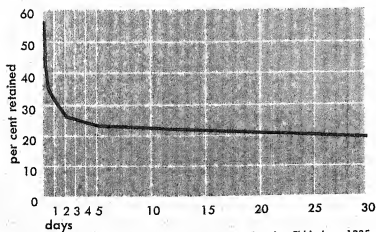


Based on Briggs and Reed, 1943

the sharp initial drop in retention, followed by gradual decline. This curve, known as the "Ebbinghaus curve," is a classic in psychology.

Retention of ideas and concepts. The general form of the retention curve has been found to be the same for poetry and meaningful prose as for nonsense syllables, although the level of retention for meaningful material is higher throughout. Memory of the substance of a prose passage, rather than the verbatim content, also follows the same pattern of initially rapid forgetting, followed by more gradual loss. The general level of retention for ideas and concepts is higher than that for verbatim quotations (Briggs and Reed, 1943). ▲

● RETENTION OF NONSENSE SYLLABLES

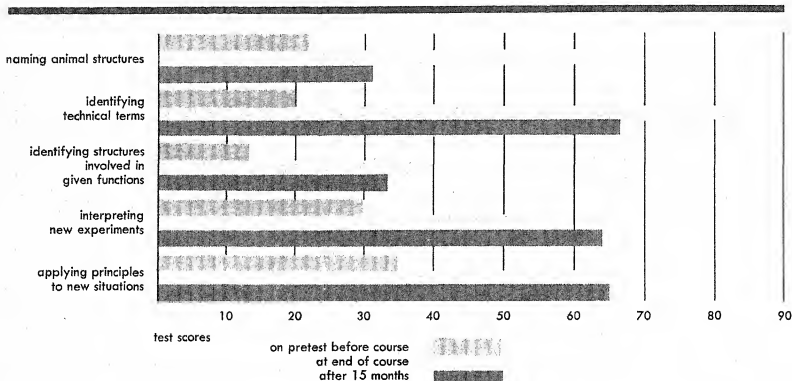


Based on Ebbinghaus, 1885

Facts vs. principles. Although most of the studies of forgetting have measured retention of specific information, some have been concerned with other learning outcomes, such as ability to make interpretations or to apply a generalization. Here it has been shown that there may be no learning loss at all even over a period of many months. The findings of one such study, in which several kinds of learning

● RETENTION OF LEARNING IN ZOOLOGY

Of all the outcomes of learning measured, the knowledge of specific facts is evidently the most transient. This finding underscores again the importance of understanding principles rather than simply memorizing facts.



Based on Tyler, 1933

outcomes from a zoology course were measured over a period of fifteen months, are shown in the graph. •

Retention of motor learning. In general, motor learning is more permanent than verbal learning. You probably cannot readily recall the poems you learned in elementary school, but if you were to try roller skating, jacks, or marbles, you would find that you have retained a surprising amount of your childhood skill, even though you have not practiced for years.

These everyday findings were confirmed by a study comparing the retention of verbal and motor skills.

Subjects learned both a list of nonsense syllables and a simple pursuit rotor task, and tests were given to different subgroups after periods of one, seven, twenty-eight, or seventy days. As shown in the graph, they demonstrated consistently better retention of the motor task, even showing increased skill during the first week after practice ceased (Leavitt and Schlosberg, 1944). ♦

Reminiscence. The phenomenon demonstrated in the study just described—a continued increase in skill after practice ceases—is called *reminiscence*. It occurs occasionally where the learning has not been carried out to complete mastery, and it has been observed with various kinds of learning, including verbal learning (McClelland, 1943), pursuit rotor learning (Leavitt, 1945), and mirror tracing (Snoddy, 1935). More recently, reminiscence was found in children's learning of geometric designs, but only after at least a four-hour delay following practice. In this case more reminiscence was found among the duller children tested (Lele, Bhatt, and Patel, 1956).

The degree of reminiscence depends on many factors, including the following:

1. *Meaningfulness of the material.* Reminiscence is greater with meaningful material than with nonsense material (Martin, 1940).

2. *Determination to recall.* Individuals who make a definite effort to recall show the greatest degree of reminiscence (Martin, 1940).

3. *Degree of mastery of the task.* In motor learning, at least, the degree of reminiscence increases up to a certain point as mastery of the task during practice increases. Beyond that point further mastery of the task reduces the degree of reminiscence observed after practice ceases (Buxton, 1943). Perhaps this is because less improvement is possible.

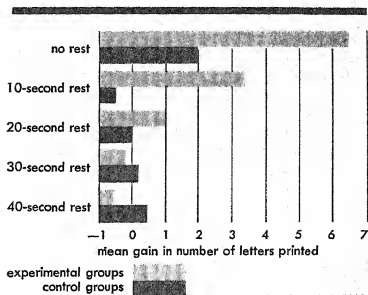
4. *Length of time involved.* Fast learners show more reminiscence than do slow learners over short periods of time (a few days to a few weeks). But slow learners show more reminiscence than fast learners over periods of a few months. This is true both for nonsense syllables and for motor learning (Leavitt, 1945).

The relation between degree of reminiscence and distribution of practice has also been investigated.

The subjects were 100 psychology students divided into ten groups, each group containing five men and five women to control for any effect of sex differences in the performance of this task. Subjects were instructed to print the letters of the alphabet upside down as rapidly as possible. All groups were given 21 trials of thirty seconds each. Two groups began each new trial immediately upon completing the preceding one (massed practice). The other groups worked under conditions of distributed practice. Two groups rested for ten seconds between trials, two groups for twenty seconds, two groups for thirty seconds, and the remaining two groups for forty seconds. This procedure was followed for the first 20 trials.

REMINISCENCE AND DISTRIBUTION OF PRACTICE

All groups made a gain on the 21st trial as compared with their scores on Trial 20. Assuming that the gain by the control groups simply represents further learning with added practice, the additional gain for the three top experimental groups can be attributed to reminiscence, since the total practice time of the groups was the same.



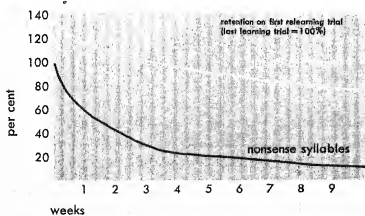
At the end of 20 trials one group of each pair was used as an experimental group and the other as a control group. The control groups went on to Trial 21 according to their usual schedule. The experimental groups were given a five-minute rest period before going on to Trial 21.

As in other studies of motor skills, the rate of original learning was more rapid with greater distribution of practice—that is, as intervals between trials become longer, the subjects gained faster. Furthermore, the experimental groups, who had rested after the 20th trial, showed a greater gain in performance from Trial 20 to Trial 21 than did the control groups. As shown in the graph, the gain was greatest for the experimental group which had had no rest between the earlier trials. It decreased as the earlier interval between trials increased, being least for the forty-second delay group (Pubols, 1960).

Do We Ever Forget Completely?

There is a slowly growing body of evidence that anything once learned is never completely

RETENTION OF VERBAL AND MOTOR LEARNING



lost—if a sufficiently sensitive method of measuring retention is employed. Obviously, the practical difficulties in conducting well-controlled experiments over a lifetime span are enormous. For this reason our evidence is fragmentary.

In one of his later experiments Ebbinghaus relearned stanzas of Byron's poem *Don Juan* after an interval of twenty-two years. At the time the relearning was started, introspection showed no evidence of memory, and there was no objective recall of the lines of the poem. The time required to relearn these stanzas was less, however, than that required to learn stanzas which had never been studied previously (Ebbinghaus, 1905).

In another case a woman of sixty repeated the answers to the 107 questions of the Westminster Catechism. She repeated 54 answers perfectly and 44 more with very little prompting. She had had no practice for forty years except for a test at the age of forty-four, at which time she had given 53 answers perfectly and 39 more with only a word or two of prompting (Smith, 1951).

Accurate records of retention of motor skills over a long span of years are rare, but the following case reflects the tenacity of motor skills once learned.

Records were kept of the three learning curves of a man who learned to type by daily practice sessions of writing a 100-word paragraph and copying a 300-word paragraph, first as a young man, then twenty-five years later, and again fifty years later.

For the 100-word paragraph, both the second and third practice curves started and remained above the

original one, with the twenty-five year curve the highest of the three throughout. The curves for the 300-word copying practice started with the same differential, but then the fifty-year curve dropped down and ran along close to the original one. No further improvement was observed after the thirty-eighth day. The leveling off of this curve was attributed to inaccurate copying as a result of poor eyesight (Hill, 1957).

During old age, long "forgotten" youthful memories tend to recur. The writer once observed a typical case of a German-born person who had come to the United States as a young man and had not used his native language for nearly sixty years. He began to complain that he found himself forgetting English words for familiar objects and that the German words kept intruding in their place. Many such cases have been reported of the spontaneous recurrence of memories of which the subjects had been completely unaware for long intervals of time. We have all noticed that older people tend to reminisce about their early life.

In a systematic survey of this phenomenon, the experimenter used three groups—a young group aged 18 to 29, a middle-aged group aged 30 to 50, and an older group aged 60 to 80. Subjects were given a list of 100 words and asked to report a life experience that they associated with each one, indicating the time of life at which each experience had occurred. Subjects in the youngest group usually associated the words with recent experiences, but beginning between the ages of 30 and 40 there was an increasing tendency to make associations with earlier experiences. With subjects who had reached the age of 70, the greatest percentage of experiences reported were those of childhood (Dent, 1956).

MAJOR THEORIES OF LEARNING

Historically, theories of learning have generally moved from broad attempts to offer an explanation for all the phenomena of learning toward theories which attempt to give a definite coherence to one particular subset of experimental findings in the field of learning—

for example, the role of spaced practice periods in facilitating learning (Underwood, 1961). While it is beyond the scope of this text to present particular theories of learning in any great detail, we shall look briefly at several major theoretical approaches to the study of

learning with which the student should become familiar.¹

Hull's Formal Theory of Learning

The best example of a formal theory of learning is that of Clark Hull. Hull attempted to construct a theoretical system which: (1) could account for the vast amount of empirical data that had accumulated; (2) derived many theorems from a relatively small number of postulates; (3) was specific and explicit enough to permit direct translation into empirical test; (4) was open to revision on the basis of new evidence, empirical proof, and further speculation; and (5) had as one of its goals quantification through the use of mathematically stated formulas. He intended his final theory to be broad in application, ranging from simple trial-and-error learning in animals to complex social learning in humans, but his death in 1952 left this plan unfinished.

From 1943, when Hull published his first theoretical system (*Principles of Behavior*) to his last statement (1952), published shortly before his death, the theory underwent continuous revision, test, and expansion. From a basic set of 17 postulates, one could deduce 133 theorems, or statements about the nature of the learning process. The Hullian theory can be summarized as follows:

1. It assumes that what is learned is a connection between a stimulus and a response. This unit of learning, an intervening variable, is called *habit strength*. It is represented by the symbol $_sH_r$, in which H stands for "habit" and the subscripts s and r simply stand for the stimulus and the response in question.

2. Reinforcement is regarded as a necessary condition for learning. For a response to increase in strength, it must be followed immediately by a goal substance. It is assumed that reinforcers gain their effectiveness by reducing the level of existing drive. Thus this theory has been called a drive-reduction theory.

3. The learned connection between a stimulus and a response ($_sH_r$) is assumed to in-

crease in magnitude gradually and continuously as a function of reinforced practice and to represent a relatively permanent change in behavior.

4. Performance of a learned response is measured through its amplitude, speed, frequency of occurrence, and resistance to extinction. Performance reflects a more transient phenomenon than does learning and is described in terms of the "excitatory potential" of a stimulus to evoke a particular response ($_sE_r$). Factors which influence whether or not a learned habit will be performed on a particular occasion include the level of drive (D), and the magnitude of the goal or reinforcer (K). Subtracting from the tendency to perform the habit are factors like the amount of effort and fatigue involved in responding. These factors are summed up in the term *reactive inhibition* (I_r). Thus the tendency of a given stimulus to evoke a particular learned response is a function (f) of the habit strength of that connection times level of drive times magnitude of reinforcer, minus reactive inhibition. These relationships are expressed in the formula

$$_sE_r = f(_sH_r \cdot D \cdot K) - I_r.$$

Kenneth Spence and others have continued to develop and refine this formulation since Hull's death.

Skinner's Approach to Learning

The strictly formal, deductive system of Hull contrasts sharply with the approach taken by B. F. Skinner. Here little use is made of concepts representing events and states which are not observable or directly manipulable; in fact, identification and measurement of Hull's intervening variables are regarded as unnecessary.

For a Skinnerian the basic issue is to discover what reinforcers sustain and control responding, rather than which stimuli evoke it. Reinforcement is defined not theoretically in terms of its drive-reducing properties but empirically: reinforcement has occurred when the probability of a response has been increased by the stimulus that has followed it. A *reinforcer* is any stimulus which, following a response,

¹Students interested in a fuller exposition are referred to a well-written text by W. F. Hill, *Learning: A survey of psychological interpretations* (San Francisco: Chandler, 1963).

increases its probability of occurrence on the next occasion.

Skinner distinguishes *respondent behavior* (such as Hull talked about), in which the response is elicited or evoked by events in the environment, from *operant behavior*, which is emitted by the organism and operates on the environment. Operant behavior can be evoked by a wide range of stimuli and can be brought under stimulus control through the process of discrimination, as we have seen. The basic operation in a Skinnerian experiment is to determine the rate at which a given operant (pecking a key, pulling a lever, or turning around, for example) is emitted under a given set of conditions (reinforcement schedules and stimulus properties).

Watson and Behaviorism

Both Hull's and Skinner's approaches dispense with consciousness and are antisubjective; thus they rely upon extensive use of animals as subjects. In fact, Hull went so far as to suggest that the tendency to impute motives and reasons to subjects in conditioning experiments should be overcome by conceptual use of a robot model to provide the "suggested prophylaxis against anthropomorphic subjectivism."

J. B. Watson was the precursor of this behaviorist tradition, a tradition which, as we have seen (p. 7), emphatically rejected the technique of introspection. He felt that the then-prevailing study of the structure of experience should be discarded in favor of a study of what organisms do—how they behave. In part, behaviorism rested upon the foundation of the conditioned reflex. In its emphasis on learning and the importance of the environment in shaping behavior, it also challenged the concept of "instinct," which had dominated American psychology in the early 1900's.

Although Watson was certainly a connectionist in his conception of what was learned, he did not refer to reinforcement as a condition for learning. According to his view, responses which have occurred recently and frequently are most likely to occur when the same stimulus is presented again.

Guthrie and Contiguity Theory

Like Watson, E. R. Guthrie emphasized the role of temporal contiguity of a stimulus event and its elicited response. He believed that learning occurs regardless of whether reinforcement is given, so long as the conditioned stimulus and the response occur together. What is learned is based upon the principle of recency: the last response made will be the act repeated. Reward acts upon learning only indirectly, by changing the situation and defining the termination of an act: it is not essential for learning to take place.

Thorndike's Reinforcement Theory

While E. L. Thorndike agreed with Watson that learning involves the gradual stamping in of S-R connections, he rejected the "law of exercise" in favor of the "law of effect" in explaining how the connections are strengthened. It is the consequence of the response, the events which follow it, which are considered significant in affecting its probability of occurrence on the next trial. Satisfying events are held to strengthen S-R connections, annoying events to weaken them. Punishment, by making behavior more variable, would thereby weaken learning. This theory, based on the hedonistic philosophy of Jeremy Bentham, is also reflected both in the extensive use of the principle of drive reduction in the Hullian approach and in the Skinnerians' dependence on reinforcement.

Cognitive Theories of Learning

The theoretical approaches described above are primarily analytical, stressing as they do units of learning, S-R connections, and discrete effects of reinforcers. They allow for great precision in the analysis of simplified learning situations (especially involving animals), but they do not appear to do justice to the complexity involved in human learning, problem solving, reasoning, and learning one's native language. In short, they minimize or ignore higher mental processes.

An alternative approach is presented by cognitive theories of learning of the Gestalt psychologists and by Tolman's purposive behaviorism. The Gestalt psychologists of the Berlin School (Max Wertheimer, Kurt Koffka, Wolfgang Köhler, and later Kurt Lewin) were primarily interested in the phenomena of human perception and thus in the experience of the subject as well as in external, observable conditions. However, the underlying principles of perception were easily carried over to a consideration of the learning process. In a very provocative book, *Productive Thinking* (1945), Max Wertheimer distinguished between the learning of a series of "correct solutions" (as typified by the atomistic approach of the behaviorist-connectionists) and learning based upon understanding. He maintained that S-R theories are adequate to handle situations of rote learning, but that productive thinking in human subjects involves the learning of underlying processes, structures, forms, and essential configurations (*Gestalten*) which can still be recognized even though all the particular elements change, as when a melody is transposed to a different key. Learning is a process of making new discriminations or reorganizing material into a new pattern. It is essentially a matter of acquiring information rather than specific responses.

E. C. Tolman's theory represents an attempt at a synthesis of several of the major lines of development described above. While he was an objective behaviorist and was not concerned with conscious experience, as were Gestaltists, nevertheless he focused upon overall patterns—"molar" rather than "molecular" behavior. According to his view, learning involves not the development of S-R bonds, but rather changes in cognitions as a result of experience with external stimuli. "Cognitions" are intervening variables built out of perceptions of and beliefs or knowledge about one's environment.

Tolman's theory shares with Hull's the important role attributed to needs and goals, but goes beyond what would be acceptable to a Hullian in the relationships he postulates between them. According to Tolman's view, needs produce demands for goals, and rewards lead to *object-cathexis* (a term borrowed from Freud), which is the tendency to seek certain goals and avoid others.

Tolman's approach could also be distinguished as one in which S-S connections are learned. He talks of "cognitive maps" and "sign-Gestalt-expectations." Individuals learn to expect an environment organized in meaningful patterns; thus they behave purposively. Organisms learn that some stimuli are signs that certain events will follow or usually are associated with other stimuli; thus stimuli not only function as response elicitors but also supply information, as cues or signs. These signs are part of a whole pattern made up of current perceptions and memories from past experience. Thus learned behavior is not merely the automatic, blind emission of responses which have been associated with particular stimuli and reward contingencies; it always involves implicit and explicit goals, and hypotheses and expectations about how to achieve them. Above all, learning is purposive and rationally directed.

Cognitive theories thus are concerned with the learning of information and generalizations, as well as particular responses. Because of their emphasis on the importance of the whole in shaping the parts and their use of analogies from field theory (see p. 124), these theories are sometimes called *holistic*, while stimulus-response theories as a group are called *associationistic* because of their assumption that learning consists in the formation of connections between previously separate elements. The cognitive theories are also called *centralist* because they emphasize organizing processes within the individual, while the stimulus-response theories are called *peripheralist* because they emphasize stimulation and reinforcement from the environment.

Current Trends in Theories of Learning

These theories have generated considerable research, as well as heated controversy. Attempts to perform critical experiments to prove one theory over another have repeatedly failed because of lack of specificity of the conditions necessary for refutation. Because of this and because of the vast accumulation of data pertinent to many different problem areas within learning, current approaches are generally less grandiose in scope. Psychologists no

longer argue about how many kinds of learning there really are or whether one formulation can ever encompass all the necessary and sufficient conditions for all cases of learning.

Researchers today are more likely to confine their attention to miniature systems generated to answer problems arising from a subset of learning phenomena. Among the miniature systems making their appearance are mathematical models to account for a narrow range of phenomena, such as the work of Bush and Mosteller (1951), and statistical learning theories, such as the work of Estes (1959). Kendler (1959) has created a *mediational* S-R theory explaining facts not predicted by single-unit S-R theory. Such approaches promise greater precision in relation to a broader range of learning issues than has been possible in the past.

CHAPTER SUMMARY

Learning is a process which brings about changes in the individual's way of responding as a result of contact with aspects of the environment. Conditioning, considered by many psychologists to be the fundamental form of learning, has been widely studied. In *classical conditioning*, first studied by Pavlov, a neutral stimulus is paired with one which elicits a response (*unconditioned response*) that is already part of the individual's behavior repertoire. The individual learns to make the same response (*conditioned response*) to the previously neutral stimulus, now called the *conditioned stimulus*. Presentation of the *unconditioned stimulus* (the stimulus which innately elicits the response) is called *reinforcement*. Reinforcement may be pleasant or aversive.

If reinforcement is repeatedly withheld after learning has taken place, the conditioned response will gradually disappear. This is known as *extinction*. Conditioned responses are apparently more resistant to extinction when reinforcement has been given only periodically (*partial reinforcement*) rather than regularly on each learning trial. Responses that have

been extinguished are usually subject to *spontaneous recovery* after a period of rest. Stimuli other than the conditioned stimulus sometimes come to evoke the same response, a phenomenon known as *stimulus generalization*. *Response generalization* may also occur.

Reinforcements which directly satisfy some need of the organism are *primary reinforcements*. However, stimuli originally associated with primary reinforcement may become rewarding in themselves; they are then known as *secondary reinforcements*. *Higher-order conditioning* occurs when a conditioned stimulus functions as an "unconditioned stimulus" in setting up a conditioned response to a third stimulus.

Conditioned inhibition occurs when a conditioned stimulus and a neutral stimulus are presented together and not followed by reinforcement; under these conditions the organism becomes conditioned *not* to respond. After a conditioned response has been extinguished, the presentation of an extraneous stimulus may reinstate it; this is called *disinhibition*. *Par conditioning* may occur during experiments and must not be confused with true conditioning. Changes in behavior due to adaptation or fatigue or a heightened state of excitement may also resemble conditioning and are known as *pseudocconditioning*.

Instrumental conditioning differs from classical conditioning in that it does not employ outside stimuli to *elicit* behavior but involves *emitted* behavior. The subject learns to make responses which will bring about the satisfaction of a need or attainment of a goal. In operant conditioning, only correct responses are reinforced. There are two kinds of instrumental aversive conditioning—*escape* conditioning and *avoidance* conditioning. Instrumental responses can be maintained at a high rate with only occasional reinforcement. A *variable ratio* schedule is most effective.

In *discrimination learning*, the subject is presented with two or more stimuli which differ or with a stimulus versus no stimulus. Such learning is often used in the application of operant techniques to practical problems.

Imprinting is a special form of learning in which hereditary patterns determine the timing and general nature of the behavior but the par-

ticular environmental resources at a critical time determine the specific response learned. Thus ducklings may learn to follow a decoy or other object rather than their own mother.

Important among the kinds of learning studied by psychologists are *verbal* learning and *motor skill* learning. Another form of learning is the learning of *attitudes*, emotional predispositions to respond in some consistent way toward objects, persons, or situations.

There is a possibility that chemical change is one aspect of learning. An increase in the production of RNA is accompanied by improved learning performance; it has been suggested that RNA molecules may actually encode memories. Brain experiments indicate that the cerebral cortex is essential to precise learning in higher animals, but subcortical structures provide the switchboard effect necessary for simple CR learning. A large expanse of the cerebral cortex is involved in learning even a highly specific response. When learning takes place, an *engram* or *memory trace* is formed in the brain; however, its formation does not ensure long-lasting memory storage, *consolidation*. A two-stage memory process also helps to explain *retrograde amnesia*, in which recent but not long-term memories are impaired.

Since learning must be inferred from observable changes in behavior, a number of *criteria of learning* are used. These include: *accuracy* of response, *speed* of response, *strength* of response, *probability* of response (useful in measuring group learning), *effort* in response, and *resistance to extinction or interference*. *Learning curves*, graphic devices for showing the amount or quality of performance after successive units of practice, are employed to give a clear picture of the course of learning. Most laboratory studies of learning performance yield curves of *decreasing returns*, although curves showing the entire learning process are *S-shaped*. Fluctuations in performance from trial to trial may not reflect irregularity of learning so much as variations in attention or fatigue. *Plateaus*, or flat places, may occur in learning curves as a result of loss of interest, change in mode of attack, or interference. Changes in reward may also affect performance without necessarily affecting learning itself. *Physiological limits* have been found for the learning of

tasks involving motor activity but not for intellectual learning.

Like learning, *retention* and *forgetting* cannot be observed directly but must be inferred from performance. This may be done by three methods: *recall*, *recognition*, or *relearning*, which is the most sensitive measure of retention. Forgetting is most rapid immediately after the end of the learning period, as Ebbinghaus discovered through his work on the learning of nonsense syllables. Ideas, concepts, and principles are retained better than verbatim material, and motor learning is more permanent than most verbal learning.

In some cases the learner can remember more at a later time than he could at the end of the practice session. This phenomenon, known as *reminiscence*, depends upon the meaningfulness of the material, the subject's determination to recall, the degree of mastery, and the length of time involved. There is a slowly growing body of evidence that anything an individual has once learned may never be completely forgotten.

There have been many different theories of what takes place in learning. Best known are those of (1) *Clark Hull*, who developed an extensive system of postulates and deductions which organized available empirical data and provided hypotheses for further experimentation; (2) *B. F. Skinner*, who attempts to avoid hypotheses about processes inside the organism and to focus on observable events, especially the relationships between responses and conditions of reinforcement; (3) *J. B. Watson*, who rejected all study of subjective phenomena and proposed that all behavior could be explained by looking at environmental conditions rather than processes inside the organism; (4) *E. R. Guthrie*, who believed that temporal contiguity was the necessary and sufficient condition for learning, reinforcement acting on learning only indirectly; and (5) *E. L. Thorndike*, who postulated S-R connections, stamped in through practice, and was the first to emphasize the importance of reward and punishment. There are also several *cognitive theories*, which differ in many respects but are alike in placing more emphasis on organizing processes within the organism and on the acquiring of information rather than simply on response learning.

Chapter 7

Outline

INFLUENCE OF MOTIVATION ON LEARNING

STRENGTH OF MOTIVATION
INTENT TO LEARN
REWARD VS. PUNISHMENT
EXTRINSIC AND INTRINSIC MOTIVATION
STRESS

CHARACTERISTICS OF LEARNING MATERIAL TO BE LEARNED

AMOUNT
MEANINGFULNESS

MEASUREMENT OF LEARNING

POSITIVE TRANSFER
NEGATIVE TRANSFER

CONDITIONS OF EFFICIENT PRACTICE

KNOWLEDGE OF RESULTS
DISTRIBUTION OF PRACTICE
CONCEPTUALIZATION AND VERBALIZATION IN MOTOR LEARNING
READING VS. RECALLING
WHOLE VS. PART LEARNING
GUIDANCE AS AN AID TO LEARNING

LEARNING UNDER SPECIAL CONDITIONS

HYPNOSIS
SUBLIMINAL STIMULATION
SLEEP
RADIATION

ABILITY TO LEARN AND REMEMBER

IS THERE AN "ALL-ROUND" ABILITY TO LEARN AND REMEMBER?
DO SLOW LEARNERS REMEMBER BETTER?
CAN ABILITY BE INCREASED THROUGH LEARNING?
HOW DOES LEARNING ABILITY CHANGE WITH AGE?

WHAT MAKES US FORGET?

INADEQUACY OF ORIGINAL LEARNING
THE IMPORTANCE OF REVIEW
INTERFERENCE FROM LATER ACTIVITY
MEANINGFULNESS AND FORGETTING
EMOTIONAL AND MOTIVATIONAL FACTORS
SOCIAL FACTORS

Chapter 7 The Management of Learning and Retention

Learning is one of the areas of psychology most relevant to the concerns of a college student. Careful study by psychologists over the past several decades has identified a number of factors which influence the quantity and quality of learning. Some of these factors are related to characteristics of the learner himself and what he brings to the learning situation. Others have to do with the content to be learned or the external situation in which the learning takes place and the learned act is performed. Some factors, such as inherent capacity, are beyond the individual's control, but knowledge of these factors can help the learner set realistic goals for his learning effort.

INFLUENCE OF MOTIVATION ON LEARNING

The relationship between learning and motivation has been investigated extensively in animals but less thoroughly in human beings because of the greater difficulty of establishing experimental control. Still, psychologists have learned a great deal about learning which can be helpful.

Strength of Motivation

Motivation, which will be discussed in detail in Chapters 11 and 12, is an intervening variable and hence cannot be observed directly. Nor have we been able to arrange conditions so that we can be sure the learner is not motivated in any way. But even without precise control, it has been possible to observe that the efficiency

of learning, as measured by both quantity and quality, usually improves as the strength of motivation increases. There are, of course, situations in which very strong motivation creates anxiety over possible failure and thus interferes with learning. Some of these will be examined later in this chapter.

Intent to Learn

One of the most important motivational factors influencing the learning performance of human subjects is the presence of a conscious intent to learn. The significance of this factor was demonstrated in some of the earliest studies of human learning.

In an early experiment subjects were instructed to count the number of O's distributed among letters printed in color on colored paper. Later they were asked what other letters were present, what color they were, and on what color paper they were printed. Their inaccurate answers showed that they had learned little if any of the material to which they had been exposed without instructions to learn (Myers, 1913).

In more systematic studies of this problem, it was found that the nature and amount of learning were clearly affected by the kind of instructions used. The experimenters found that when no specific instructions were given, subjects attained only a general comprehension of the material; but when they were given exact instructions about what to learn, their learning became specific to those instructions (Postman and Senders, 1946; Postman and Adams, 1957).

Experiments of this nature are complicated by the fact that instructions can come from the experimenter or can be self-imposed by the subject. In the latter case, the subject may learn

certain incidental aspects of the material even though they are not directly related to the assigned task. In one study, for example, in which the experimenter gave subjects material to read but did not instruct them to learn, some of the subjects reported deliberate and consistent self-instruction to learn (Jenkins, 1933). Thus, when incidental learning occurs, it is always possible that the subjects have instructed *themselves* and thus had an intent to learn. Modern instructors in schools and industry make an effort to increase the learner's intent to learn before presenting the subject matter.

Reward vs. Punishment

Experimental studies have shown that the strength and nature of rewards or punishments administered by a teacher or experimenter influence the learner's rate of learning, as measured by his subsequent performance. The individual's own evaluation of his progress can also be rewarding or punishing. Numerous studies have shown that learners usually respond better to encouragement than to discouragement (Gates and Rissland, 1923; Sears, 1936).

A comprehensive experiment studied the combined effects of encouragement or discouragement and high or low motivation.

The subjects, forty college students, learned two lists of seventeen nonsense syllables by the serial method. First, all were given fifteen trials on List A with no special instructions. These trials were used as a basis to divide them into two groups of equal learning ability. To produce high motivation in the members of one group, the experimenter told them that the task was really a short intelligence test measuring ability to think in abstract terms as well as to memorize. The remaining subjects—the "low-motivation" group—were told that the experimenter was investigating the associational value of the nonsense syllables and was not interested in the subjects' performance as such.

All subjects were then given fourteen trials on List B, after which half of the subjects in each group, chosen at random, were told that they had done worse than the others and had not even reached college level on the test. The experimenter told these "failure" groups that people usually learned as many syllables as they had in half the time; he asked questions such as, "Is anything

wrong? Do you feel all right?" "Nonfailure" subjects, on the other hand, merely took part in a brief conversation with the experimenter about campus activities. All subjects were then given one more trial, the fifteenth, on List B and told to return twenty-four hours later. The next day they were given five more trials on list B, after which all "failure" subjects were told that their performance had actually been excellent.

Correct Responses on Immediate Test (Trial 15)

Motivation	Failure	Nonfailure	Both
Low	7.4	12.2	9.8
High	10.8	11.2	11.0
Both	9.1	11.7	

Correct Responses on Delayed Test (Trial 16)

Motivation	Failure	Nonfailure	Both
Low	5.5	6.7	6.1
High	8.4	9.8	9.1
Both	6.95	8.25	

As the tables of results show, the "high-motivation" subjects as a group did somewhat better than the others on both tests, with an increased differential on the delayed test. The "failure" subjects as a group did less well than "non-failure" subjects on both tests, and reports of failure appeared to have a greater effect on the "high-motivation" subjects (Sarason and Sarason, 1957).

Present indications are that reward may be more effective at the beginning of a series of learning trials and punishment more effective during the final phases of learning (Murata, 1959). This finding ties in with the fact that the stress caused by punishment tends to interfere with new, unstable habits but is less disruptive to older, better established habits.

As an aid to learning, punishment is most effective when used in combination with reward. When an undesirable response is suppressed because of punishment, the subject may try some alternative response which, if more desirable, can then be reinforced by reward (Commins and Fagin, 1954). In this way reward and punishment together set up cues as to what is correct and what is incorrect—something that punishment cannot do alone. To be effective, punishment should always be given in

such a way that the learner knows clearly what specific response is being punished.

Extrinsic and Intrinsic Motivation

Laboratory studies of learning in animals usually have depended upon what is called *extrinsic* motivation (for example, hunger, thirst, and escape from electric shock) which can move the subject to action but which has no inherent relationship to the task to be learned. This has been necessary with animal subjects to ensure that they would be active enough to make the responses that were to be learned. It also has the positive advantage of enabling the experimenter to "control" the factor of motivation for all subjects—to specify what motives are acting and to what degree.

With human learning studies, the situation is more complex. The experimenter usually does not have the same control over his subjects' physiological needs, and he can never know how far learning performance is being affected by factors he cannot see—such as self-instruction, a need to achieve, or a high level of aspiration. This is a further reason why so much work on learning has been done with animal subjects.

Report cards, honor rolls, and gold stars are examples of *extrinsic* motivation used in the schoolroom. It has been found that such devices motivate some children more strongly than others, however, and that both learning and remembering tend to be better when the motivation is *intrinsic*—when the pupil is interested in the learning task and eager to learn it for its own sake. Thus today's teachers rely less on rewards and punishments and try to build interest in the material to be studied, so that learning becomes a reward in itself. When learners feel a *need* to know and are active in searching for information and answers, they understand and remember what they learn better than when the same material is simply presented to them for memorization.

In everyday learning situations, both *intrinsic* and *extrinsic* motivation often are involved. Learning may be sought for its own sake and also as a means to some other goal. The Boy Scout is eager to learn the Morse code because it is fun to communicate in secret with his

friends but also because he wants to advance his scouting rank and win the acclaim that goes with it. Similarly, the scientist does research to advance knowledge in a particular field but also to gain recognition and advancement.

Stress

When an individual is motivated to achieve a certain level of proficiency in performing a task, failure or threat of failure produces stress. Working under the pressure of time or under distracting conditions also induces stress in the learner. Individual differences are extremely important in determining just how stress influences learning.

A large group of college students were told that they were about to take an intelligence test which was an excellent predictor of college success and that the results would influence their status in school. The subjects were then administered the digit-symbol subtests, a learning task from the Wechsler-Bellevue intelligence scale. After the test the papers were collected, presumably for correction. An hour and a half later, the names of part of the group were read off and instructions were given for these students to report to another room. The students remaining in the original room (who had actually been matched with the others as to grade-point average) were then told that they had done very poorly on the intelligence test, whereas the other group had done satisfactorily. It was explained that failure was a serious affair and that they would therefore be given another chance. Following this stern warning, which presumably placed them under stress, they were given an alternate form of the same test. At intervals during the test the experimenter further increased stress by calling out false norms which were impossible to achieve. For example, he would say, "You should have finished line B," at a time when the students could not yet have finished that much.

Meanwhile, the subjects in the other group were also given the alternate form of the test. But they were told that they had performed well on the first test and that they were to take the second test only to be sure that their true ability had been measured. They were urged to improve their performance if possible, since their final score would be the average of the two testings. These subjects were also interrupted by the experimenter's calling out norms, but the norms in this case were realistic ones.

Surprisingly enough, the average number of correct responses on the second test was the same for both groups. The students under stress, however, made a greater number of total responses. They showed an increase in speed of performance as compared to the nonstress group, but this increase in speed occurred at the expense of accuracy.

The most interesting result of this study was its indication of individual differences in performance under stress. The members of the stress group obtained scores over a much wider range on both sides of the average than did the nonstress subjects, whose scores were bunched more closely together. Under stress, some individuals did better and others did worse (Lazarus and Erickson, 1952).

That frustration increases the length of time required for learning, partly because it increases stereotyped behavior, was shown in an experiment with 144 subjects.

Each subject was seated before a screen on which a red light flashed every five seconds, as a signal for the subject to press one of two keys. If he pressed the "correct" key, a white light flashed; if he pressed the "wrong" one, a buzzer sounded. The keys were attached to a hidden recording mechanism which made a graphic record of the amount of pressure exerted, as a measure of the subject's vacillation.

The subjects, young men and women of similar socioeconomic background, were divided at random into six groups and given a problem which could not be solved—that is, the white light and the buzzer were used haphazardly rather than according to any predetermined pattern of correct responses. Two groups were given five trials, two groups fifty trials, and two groups one hundred trials. In each case members of one group were given a strong incentive by being told that performance in learning patterns such as these was a good test of intelligence and that they should be able to solve the problem in two minutes. Members of the other group were told that the experimenter was using them merely as a sample group in order to test the difficulty of the problem. After frustrating attempts, all groups worked on patterns which could be mastered.

In the amount of time required to learn these final solvable patterns, there was a highly significant difference between the mildly frustrated subjects and those who had been subjected to 50 or 100 impossible tasks. The difference between the 50-trial and the 100-trial groups was slight, however, indicating that after a

certain point further frustration had little effect on learning time. The incentive groups learned the new material somewhat more slowly than did the nonincentive groups.

If a subject struck the same key more than six times consecutively, his response was regarded as stereotyped. Again there were highly significant differences between the mildly frustrated groups and both sets of severely frustrated groups, not only in the duration of stereotyped responses but in the proportion of stereotyped responses to the total number of responses. However, the 100-trial group had slightly fewer stereotyped responses than the 50-trial group.

Only about 41 per cent of the subjects showed vacillation, but those who did passed through an initial steady period with little vacillation, an intermediate period with fairly marked vacillation, and a concluding period in which vacillation fell to zero. Vacillation decreased during stereotyped responses, indicating that stereotypy provided some degree of adjustment to frustration. Reports given by the subjects indicated that most of them felt disturbed and hostile, but none realized that the frustrating problems were unsolvable. Most of them were quite unaware that they had shown stereotyped responses (Jones, 1954).

There is evidence that stress may *help* performance when an existing response is to be strengthened, but *impede* it when a new response is to be substituted for an old one (Palermo, 1957). Stress, like punishment, seems to have less disturbing effects late in learning than during the early stages (Castaneda and Lipsitt, 1959).

The dynamics of stress evidently involve a complex relation between strength of motivation, degree of frustration, and personality factors. In some cases and under some conditions, threat of failure seems to motivate the learner strongly to work for success, thereby facilitating performance. In other cases, however, the emotional components of stress seem to be so disturbing that they disrupt performance, producing "mental blocks" or severe anxiety reactions which distract the learner from his task.

Anxiety can interfere with effective learning by reducing the individual's ability to discriminate clearly.

In one study, subjects were tested for anxiety before taking part in eyelid-conditioning experiments. All

subjects were then given sixty conditioning trials in which a light appeared in the right-hand one of two windows and was invariably followed by an air puff delivered to the right eye.

Next, all subjects were given a series of discrimination trials in which the light appeared sometimes in the right window, as before, and sometimes in the left one. An air puff always followed the light in the right window and never the light in the left window. The anxious subjects tended to blink in response to both lights, whereas the nonanxious subjects were more selective in their responses, blinking less often to the light on the left (Hilgard, Jones, and Kaplan, 1951).

Anxious individuals, who tend to regard many situations as threatening, are thus handicapped in new learning where precise discriminations are required.

Anxiety interferes with the learning of new material and material that contradicts previous

learning more than it does with the learning of familiar material.

Two groups of students, differing in their anxiety level, learned two different types of paired-associate materials—meaningful words, such as *man-boy*, and inaccurate arithmetic combinations, such as " $2 \times 3 = 9$." Half of the learners in each group then were tested under "immediate" conditions and half under "delay" conditions. High-anxiety and low-anxiety subjects showed no significant differences in the tasks involving familiar meaningful material on either immediate or delayed testing. However, with the tasks involving contradictory material the high-anxiety students learned significantly less and also learned more slowly (Korchin and Levine, 1957).

This tendency for anxiety to increase the effects of interference is a major consideration in the designing of military or other equipment that must be operated under stress.

CHARACTERISTICS OF THE MATERIAL TO BE LEARNED

It is common experience that we learn some things more easily than others. Sometimes this is explained by motivational factors, as we have just seen, or by other conditions in the learning situation. Equally important in most cases are the amount of material to be learned and its meaningfulness. These will be examined in turn. Sometimes these conditions can be managed at will by the student; at other times they are under the control of the teacher or the author of the material being studied.

Amount

A verbal learning task so brief that the learner can master it in a single presentation is said to lie within his *memory span*. College students usually have a memory span of seven or eight units (such as digits or letters) if the material is presented orally; they can seldom repeat a list

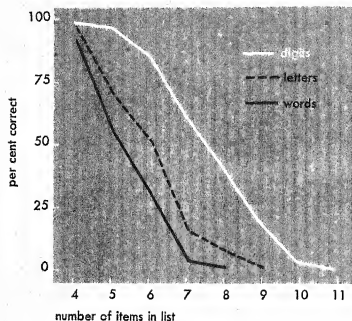
of more than nine or ten items following a single presentation. It is of interest that local telephone numbers, even in a large city exchange, do not have more than seven digits and letters.

The usual memory span for letters is slightly less than that for digits, according to exhaustive research done in the Bell Telephone Laboratories. This is one reason the old prefixes of our telephone numbers are being replaced by digits (Deiminger, 1960).

With amounts of material greater than the memory span, there is an increase not only in the total length of time required for learning but also in the average amount of time required for learning each unit of material. For example, a person who can learn a list of seven nonsense syllables in a single presentation might require three or four repetitions to learn a nine-syllable list and nine or ten trials to learn ten syllables. The rise in difficulty of nonsense-syllable lists, as tested by immediate recall, begins to level off

MEMORY SPAN FOR DIGITS, LETTERS, AND WORDS

As these curves show, memory span is longest for digits and shortest for words, with the span for letters falling somewhere in between. Since there are only nine possible digits as compared with twenty-six possible letters and many more possible words, the experimenters used only nine letters and nine three-letter words in making up their lists of letters and words. The curves did not significantly differ from these, however, when they tried lists of letters and words not limited in this way.



Based on Crannell and Parrish, 1957

when the list is about twice as long as the memory span (Shurrager, 1940). Beyond that point increased length of material adds little to its difficulty, unless the list is lengthened considerably. For short lists, in other words, increase in difficulty is disproportionately greater than increase in length; for longer lists, increase in difficulty is disproportionately less. ■

Although the memory span is shorter for words than for digits, it has been shown that the increased learning time per unit with increased length of material is considerably less striking with meaningful material, even though there is an increase in the number of ideas presented. It has also been shown that where the learner has only to master the essential ideas of a passage rather than learn the material verbatim, increased length has a com-

paratively small effect on learning time (Cofer, 1941).

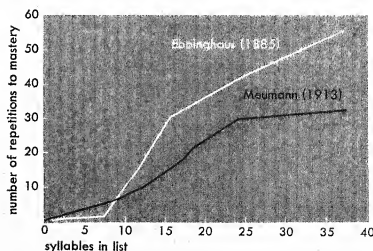
Meaningfulness

Many studies employing both meaningful and nonsense materials have demonstrated clearly that the rate of verbal learning depends greatly upon the meaningfulness of the material.

In one early study, a group of subjects learned 200 nonsense syllables, 200 single digits, 200 words of meaningful prose, and 200 words of meaningful poetry. This procedure provided a comparison of the rates of learning for equal amounts of material with different degrees of meaningfulness. The relative difficulties of the different kinds of material were determined by the average time taken to learn each set, as shown below (Lyons, 1914).

Kind of material	Minutes needed to learn (average)
Nonsense syllables	93
Digits	85
Meaningful prose	24
Meaningful poetry	10

It is clear that the meaningful prose and poetry were learned more readily than either the

DIFFICULTY AND AMOUNT OF MATERIAL

Based on Hull and others, 1940

nonsense syllables or the digits. As meaningfulness decreases, more trials are required for learning and there is more variability from trial to trial (Dowling and Braun, 1957). Such findings are merely scientific confirmation of what might be expected on the basis of common experience.

Even where there is no intent to learn, meaningful relationships facilitate learning.

In one study subjects were told that the experimenter wanted samples of their handwriting and were given fifteen pairs of words to copy. All the words were meaningful, but there were systematic differences in the degree of relatedness of the various pairs. When the subjects were asked to recall as many of the pairs as

they could, it was found that the degree of recall was closely related to the amount of meaningful relationship between the paired words (Mayzner and Tresselt, 1962).

Good teachers and curriculum planners take great pains to make their subject matter meaningful. They proceed, when possible, from the familiar to the new, from the simple to the complex.

Here, as with motivational factors, interactions are often found, further attesting to the complexity of the learning process. For example, the rate of presentation most beneficial for learning lists of meaningful words is too fast for the most efficient learning of nonsense syllables (Carroll and Burke, 1965).

INFLUENCE OF PRIOR LEARNING

The efficiency of practice is often influenced by what we have already learned or have been learning just before. The experimental design used to study this effect is quite simple:

Experimental Group	Control Group
Learn Task A Learn Task B	Do not learn Task A Learn Task B

If the experimental group learns Task B better than the control group does, the effect is called *proactive* (forward-acting) *facilitation* or *positive transfer*: the learning of Task A has facilitated the learning of Task B. If the experimental group learns Task B less well than the control group does, the effect is called *proactive inhibition* or *negative transfer*. It has been suggested that the phenomenon of proactive inhibition may explain why amounts of material beyond the memory span become increasingly difficult to learn.

Positive Transfer

Results from various studies indicate that positive transfer will result when the prior task

and the present task have some similar stimulus-response combinations. When the same stimuli as those used in the prior activity are to be related to different responses in the present activity, negative transfer is likely. When the two learning situations have nothing in common, there is no transfer at all.

The facilitating effect of common elements on the learning of a new task is shown in the following study, in which subjects learned to associate colored lights with certain lever positions.

The subjects, 300 male college students, first were given Task I, which consisted of learning which position of a lever was "correct" when each of six colored lights was presented. They then were given Task II, in which different lever positions were correct for some or all of the lights. Three degrees of intertask similarity were tested: two associations new (high similarity), four associations new (medium similarity), and all six new (low similarity). Even in the last case one would expect a general facilitation as a result of familiarity with the apparatus and procedure. The effects of positive transfer on Task II are shown by the fact that the learning curves for all three degrees of similarity start and remain above

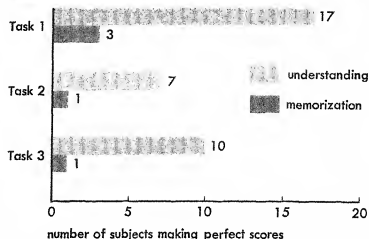
the level of the composite learning curve for Task 1 (Duncan, 1953).

Almost everybody has had the experience, when in a new place, of feeling that the place is familiar. This experience is so common that the French have a term for it, *déjà vu*, which means "already seen." How can one "remember" a place or situation one has not been in before? The ancients of some cultures answered the question by maintaining that their souls must have been there in another body. The psychologist views this phenomenon as a case of transfer of a common element. Many complex situations have some detail in common. This common detail, having been experienced before, is recognized in the new situation.

This explanation finds support in a conditioning experiment. Subjects were first conditioned to various visual, auditory, or tactual stimuli; these were then presented as elements in more complex stimulus patterns. In the case of visual stimuli, there was some tendency for the compounds to elicit the conditioned response (Grings and Kimmel, 1959).

Specific transfer effects are generally too small to justify a student's learning one subject

◆ TRANSFER AFTER UNDERSTANDING



Based on Hilgard, Irvine, and Whipple, 1953

in the hope that it will help him learn another subject later. On the other hand, methods and techniques of work, ideals and attitudes, and knowledge of general principles and relationships may readily be transferred from one school subject to another.

The importance for maximum transfer of understanding general principles, as opposed to merely learning by rote, has been shown in a series of studies in which high-school students learned a number of card tricks.

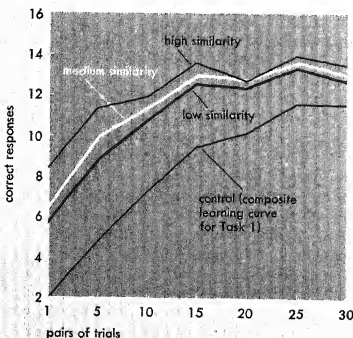
One group of subjects simply learned the order of the cards by rote memory; the other group were taught the principles of the tricks. It was found that the understanding group required more time to learn the tricks than did the memorizing group. Overnight retention was equal for the two groups. But when three new problem-solving tasks involving some of the same principles were presented, subjects in the understanding group were much more successful at the new tasks than were those in the memorization group (Hilgard, Irvine, and Whipple, 1953).

There is also evidence that amount of transfer is proportional to degree of original learning (Mandler and Heinemann, 1956).

Negative Transfer

It is as important for the student or teacher to avoid the conditions that produce negative

▲ POSITIVE TRANSFER



Based on Duncan, 1953

transfer as to establish the ones that bring positive transfer. The baseball coach is trying to prevent negative transfer when he forbids his players to play golf during the baseball season; he knows that the curved swing used in golf would interfere with the horizontal swing required in baseball.

An important experiment in this area brings together the findings of a number of previous studies.

Three groups of subjects each learned two lists of paired nonsense syllables. The first list was the same for all groups. The second was made up in a different way for each group: (a) the list presented to one was made up of entirely different syllables; (b) the list presented to one preserved the original response syllables but used new and different stimulus syllables; and (c) the list presented to one used the original stimulus syllables with new response syllables.

The results of this experiment are shown in the following table (Bruce, 1933).

Original pair	Changed pair	Per cent of learning time saved
(a) xal-pom	cam-lup	16%
(b) lan-qip	fis-qip	37
(c) req-kiv	req-zam	-9

The first line in the table shows that some time was saved even when there were no similar elements. As we would expect, previous practice in memorizing and general adaptation to the experimental situation had made the second list easier to learn. The second line shows very clearly that there was a *positive* transfer when an original response was associated with a new stimulus word. That is, there was an improvement in the learning of the response in a new situation as a result of having learned it before. The third line shows that when a new response had to be attached to an old stimulus, there was *negative* transfer: the new learning was made more difficult.

CONDITIONS OF EFFICIENT PRACTICE

Much careful research over the past seventy years has helped psychologists to determine the conditions that are most conducive to efficient learning. Important among the factors affecting the efficiency of learning are knowledge of results, distribution of practice, conceptualization and verbalization, reading vs. recalling, whole vs. part learning, and teacher guidance.

Knowledge of Results

Considerable experimental evidence indicates that a person who has knowledge of his progress will learn more rapidly than an equally motivated subject of comparable ability who is working "in the dark" (Ammons, 1956). In recent years psychologists have tended to replace the term *knowledge of results* with the more

general expression *psychological feedback* (Brown, 1949). Psychological feedback is the process whereby the individual gains information concerning the correctness of his previous responses in order that he can adjust his behavior to compensate for errors. Such information may be provided in either of two ways: (1) the individual may be told of the correctness of each specific attempt or response as it is made, or (2) the individual may be kept informed of the overall progress of his learning.

An interesting example of the first method is an experiment conducted during World War II on training gunners to "track" targets with a 40-mm. gun. The task in tracking involves continuous sighting of the gun on a moving object. Tracking with this gun required two men—one to follow the horizontal movements of the target, the other to follow the vertical movements. The standard

Army method of training in this skill was to give verbal instructions and coaching before, during, and after each session of gunnery practice.

Three experimental conditions were used to test the efficiency of this training method. For Group A the standard Army method was used; in Group B each man coached his partner; and in Group C a special telescopic sight mounted on the gun was used to check the accuracy of aim, so that the instructor could sound a buzzer whenever the gun was off target, giving the men immediate knowledge of results. The men in Group C were also told what scores they had made at the end of each training session. As the graph shows, the men in this group improved much more rapidly than did those in the other groups and achieved the greatest proficiency. The standard Army method proved the least effective of the three (Bray, 1948).

This finding has been verified in many situations. ♦ One well-designed experiment showed that knowledge of results, whether given early or late in training, was the decisive factor in the learning of a lever-positioning task.

The subjects, 160 airmen in training, were asked to discover how hard they must pull on a rope to displace a hidden lever by a predetermined "correct" amount. Knowledge of results, when given, consisted of such phrases as "eight units high" or "five units low." The subjects were divided into four groups, each required to make 24 attempts. All subjects were given knowledge of results after each of the last 5 tries. Group O had no other knowledge of results; Group 2 had knowledge of

results after each of the first 2 trials; Group 6 had knowledge of results after each of the first 6 trials; and Group 19 had knowledge of results after every trial.

Group O showed no significant change in number of errors during the first 19 trials. Groups 2 and 6 improved while they were given knowledge of results but showed increasing errors after knowledge of results was withdrawn, although they did not regress to the level of errors made on the first trial. Group 19 improved steadily throughout—rapidly at first, more slowly later. Group O showed roughly the same decrease in errors in trials 20-24 (the only trials in which they received knowledge of results) that Group 19 had shown on the first 5 trials. That is, the greater familiarity of Group O with the apparatus after 19 practice trials had produced no "latent learning" and had virtually no effect on accuracy of performance. It was knowledge of results that counted in producing learning (Bilodeau, Bilodeau, and Schumsky, 1959).

The influence of a delay, either before the subject receives knowledge of results or before he makes the next trial, has also been studied.

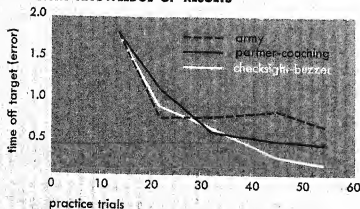
In one experiment, subjects had to draw a three-inch line while blindfolded, with information concerning the accuracy of the line being delayed for 0, 10, 20, or 30 seconds. Lengthening the delay reduced the rate of learning, but even the longest delay gave better results than were obtained when no knowledge of results was given (Greenspoon and Foreman, 1956).

Distribution of Practice

Suppose you have a month for some learning task, such as memorizing the lines of a play or acquiring some simple motor skill. Suppose also that you can afford to devote only thirty hours to practice. In such circumstances, should you practice six hours a day for five days, ten hours a day for three days, or one hour on each of the thirty days? All these schedules would involve the same total amount of time devoted to learning. The choice, essentially, is between *distributed practice* (short, spaced learning periods) and *massed practice* (long, concentrated learning periods). Which schedule of learning will bring the greatest and most permanent improvement?

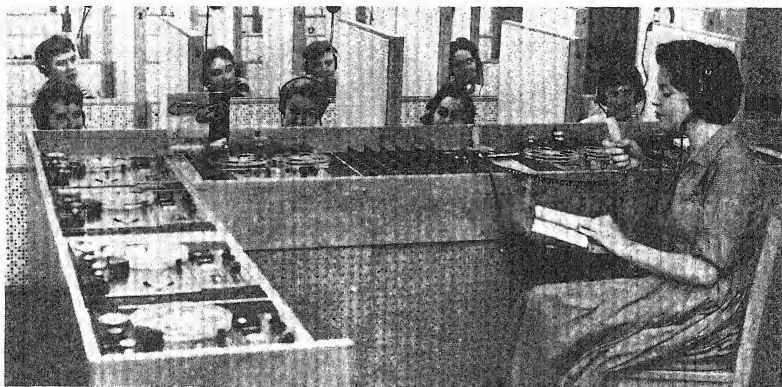
Several factors help to determine which distribution of practice is most efficient in a given

IMPROVED PERFORMANCE
WITH KNOWLEDGE OF RESULTS



Based on Bray, 1948

◆ Language laboratories such as the one shown here have been designed to facilitate learning by giving students immediate knowledge of results. The students, in individual booths, listen to and imitate tape recordings of the language they are studying. The instructor "listens in" on the responses of different individuals, correcting pronunciation errors as they are made. Students can also make tape recordings and play back their own responses.



case. Many tasks require a period of preparation before work can be started in earnest. Before beginning an assignment, a student may have to gather his materials together, sharpen his pencil, adjust the light, find his place in the book, and begin to organize his thinking. This preparation takes time, but it need not be repeated during a particular study period. Thus, under conditions of massed practice the student would lose considerably less time in warming up than he would if he distributed the same amount of learning time into a number of short practice sessions.

An obvious advantage of massed over distributed practice is the fact that considerable forgetting may occur between learning sessions, especially if the sessions are placed too far apart. On the other hand, performance which requires effort also produces fatigue. The greater the physical or mental effort involved in a task, the greater the degree of muscular and nervous fatigue that results from practicing it. In tasks requiring considerable effort, therefore,

distributed practice may be superior, for rest pauses overcome the lowered efficiency which accompanies fatigue.

Fatigue is a powerful factor in any learning that involves physical exertion, but boredom affects mental work to a greater extent than does fatigue. Even the most interesting activity tends to become boring if it is continued too long. Such boredom lowers motivation and reduces attentiveness. Thus an advantage of distributed practice may be that it serves to keep interest fresh and to maintain a satisfactory level of motivation.

Distributing rote learning. Psychological studies have consistently shown that rote, or verbatim, learning of verbal materials progresses more rapidly when practice is distributed in frequent, short periods.

A classic experiment first performed more than a half century ago and replicated by other investigators a quarter of a century ago (Henry and Wason, 1939)

compared four different methods of using two hours of time to memorize a code. One group of subjects practiced for ten minutes twice a day for six days; a second group practiced twenty minutes once a day for six days; a third group practiced forty minutes every other day for six days; and a fourth group practiced two hours at one sitting. The first two groups learned most effectively and were about equal in efficiency. The group which practiced two hours at one sitting was the least efficient of the four, while the group which practiced forty minutes every other day was intermediate (Starch, 1912).

More recent studies have, on the whole, produced comparable results (Underwood, 1953c, 1953d). As the complexity of the rote learning task increases, however, distributed practice tends to lose its margin of superiority.

In a study in which nonsense syllables had to be learned in pairs, distributed practice did not bring more rapid learning although it did result in fewer errors (Underwood, 1953a). In the learning of pairs of adjectives, items which needed to be practiced only a few times for learning to take place were better retained if acquired by distributed practice. Items which needed many trials, on the other hand, were better retained following massed practice (Underwood, 1953b).

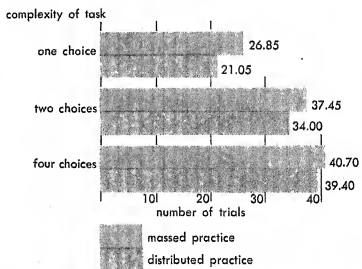
More complex items, which the learner must go over several times, would thus seem to be learned more efficiently in longer practice periods. Other studies indicate that as the task becomes more complex and requires either choice or a large degree of discovery, massing may actually become superior to distribution (Cook, 1934; Ericksen, 1942; Riley, 1952). •

Distributing ideational learning. The superiority of distributed practice tends to decline or disappear as subject matter becomes more meaningful. Whereas nonsense material (or, indeed, verbatim learning of any kind) usually becomes boring, ideational material is generally much more interesting and will maintain motivation over a considerably longer period of time. A student might easily concentrate for an hour or two on an interesting assignment, especially if he is trying to grasp general ideas and new relationships. For learning ideas and principles, the best procedure seems to be a period of massed learning followed by distributed learning.

In logical reasoning problems, massed practice has been shown to be generally superior.

When college students were given twenty minutes to solve a problem in reasoning, those who worked without interruption for the whole time did better than those who worked for a minute at a time with thirty-second rest periods (Shaklee and Jones, 1953).

Sometimes, of course, an individual devotes a long, concentrated period of study to some task and still makes little progress in grasping the basic relationships. This is particularly true of some types of problem solving, such as those the student encounters in mathematics or physics. This failure to show progress may be due to a persistent mental set which is interfering with perception of new relationships. Investigation has shown that this type of interference is more likely to develop under massed than under distributed practice.



● COMPLEXITY OF TASK AND DISTRIBUTION OF PRACTICE

In this study correct nonsense syllables had to be associated with meaningless symbols. In the first case, it was a matter of simple rote memory. In the second case, subjects had to discover which of two syllables was correct for each symbol. In the third case, they had to discover the correct one of four presented. Learning time increased as complexity increased, and the advantage of distributed practice was gradually lost.

In one study, two groups of subjects were given a series of simple arithmetic problems which involved manipulating the contents of different-sized containers in order to obtain a specified amount. For example, they had to figure out how to get 40 cubic inches of beans from a bin by using three containers that would hold 29, 59, and 5 cubic inches respectively. One solution to this problem is to fill the largest container; empty 29 cubic inches from it into the 29-cubic-inch container; and then add 10 more cubic inches by filling the smallest container twice. This leaves the specified amount of beans in the large container.

A series of such problems, all of which could be solved by this same formula, were given to both groups of subjects. Group I were given the problems one right after another, whereas Group II had a three-minute rest period between problems. Then both groups were given a test problem which could be solved either by the same formula or more directly by simply subtracting the contents of one container from another. The results showed that only 26 per cent of Group I (massed practice) solved the test problem by the direct method, whereas 48 per cent of Group II (distributed practice) did so. Evidently the mental set leading to an indirect solution was greater for the group which had massed practice in using the indirect method (Kendler, Greenberg, and Richman, 1952).

These results suggest that when little progress is being made in solving a problem, the most efficient procedure may be to drop the activity temporarily and return to it after an interval of rest. Sometimes things look quite different when they are reexamined after being put out of mind for a time.

Distributing motor learning. Distribution of practice is especially advantageous in motor learning because it largely eliminates the effects of muscular fatigue.

In one typical experiment two groups of twenty-five subjects tried to keep a stylus in contact with a moving brass target which rotated in a heart-shaped pattern. Both groups received thirty fifteen-second trials a day for two days. The distributed-practice group had a forty-five-second rest period between trials; with a five-minute rest period at the end of each block of six trials. The massed practice group had no rest periods except for the five minutes at the end of each six trials. Performance

was measured in terms of the number of seconds per trial that the subject made contact with the moving target. Although the groups were equivalent in performance at the outset, the distributed-practice group showed consistently superior performance thereafter. In fact, their performance was already clearly superior at the end of the first six trials (Barch, 1952).

Motor tasks may be machine-paced or man-paced. When the equipment used has a constant speed to which the subject must adapt himself, the task is *machine-paced*. When the subject can work at his own rate and control the speed of the apparatus, the task is *man-paced*.

A recent study using a pursuit rotor compared the effects of massed and distributed practice on the two types of pacing. For machine-paced work the turntable revolved at a constant speed of 60 revolutions per minute, but during man-paced work its speed depended upon the length of time the subject was able to maintain contact with the target. On each trial the rotor started and moved faster until contact was lost. If the subject held the stylus on the target for an appreciable length of time, the turntable would reach the maximum speed of 60 revolutions per minute. Thus, under machine-pacing, the task was extremely difficult from the beginning, while under man-pacing it became progressively difficult as skill developed. An earlier study using a man-paced rotor had found that the poorest subject could hold the stylus on the target only when the rotor was stationary or nearly so (Ruch, 1934). Time on target varied considerably for the two conditions, most man-paced subjects maintaining contact for a while even at the beginning whereas the machine-paced subjects lost contact almost immediately on early trials and never maintained contact for as long a time on any given trial. Thus the man-paced subjects spent considerably more time actually practicing the new skill than did the machine-paced subjects.

The college students, sixty-nine men and seventy-one women, who served as subjects were divided into four groups: distributed-machine-paced, massed-machine-paced, distributed-man-paced, and massed-man-paced. All subjects worked for a total of ten minutes. For the massed-practice groups, practice consisted of two blocks of five minutes each, with a rest period of one minute between them. The distributed-practice groups were given forty trials of fifteen seconds each, alternating with fifteen-second rest periods.

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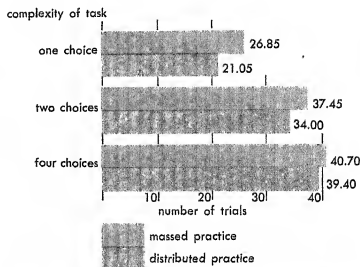
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In this study correct nonsense syllables had to be associated with meaningless symbols. In the first case, it was a matter of simple rote memory. In the second case, subjects had to discover which of two syllables was correct for each symbol. In the third case, they had to discover the correct one of four presented. Learning time increased as complexity increased, and the advantage of distributed practice was gradually lost.

In one study, two groups of subjects were given a series of simple arithmetic problems which involved manipulating the contents of different-sized containers in order to obtain a specified amount. For example, they had to figure out how to get 40 cubic inches of beans from a bin by using three containers that would hold 29, 59, and 5 cubic inches respectively. One solution to this problem is to fill the largest container; empty 29 cubic inches from it into the 29-cubic-inch container; and then add 10 more cubic inches by filling the smallest container twice. This leaves the specified amount of beans in the large container.

A series of such problems, all of which could be solved by this same formula, were given to both groups of subjects. Group I were given the problems one right after another, whereas Group II had a three-minute rest period between problems. Then both groups were given a test problem which could be solved either by the same formula or more directly by simply subtracting the contents of one container from another. The results showed that only 26 per cent of Group I (massed practice) solved the test problem by the direct method, whereas 48 per cent of Group II (distributed practice) did so. Evidently the mental set leading to an indirect solution was greater for the group which had massed practice in using the indirect method (Kendler, Greenberg, and Richman, 1952).

These results suggest that when little progress is being made in solving a problem, the most efficient procedure may be to drop the activity temporarily and return to it after an interval of rest. Sometimes things look quite different when they are reexamined after being put out of mind for a time.

Distributing motor learning. Distribution of practice is especially advantageous in motor learning because it largely eliminates the effects of muscular fatigue.

In one typical experiment two groups of twenty-five subjects tried to keep a stylus in contact with a moving brass target which rotated in a heart-shaped pattern. Both groups received thirty fifteen-second trials a day for two days. The distributed-practice group had a forty-five-second rest period between trials; with a five-minute rest period at the end of each block of six trials. The massed practice group had no rest periods except for the five minutes at the end of each six trials. Performance

was measured in terms of the number of seconds per trial that the subject made contact with the moving target. Although the groups were equivalent in performance at the outset, the distributed-practice group showed consistently superior performance thereafter. In fact, their performance was already clearly superior at the end of the first six trials (Barch, 1952).

Motor tasks may be machine-paced or man-paced. When the equipment used has a constant speed to which the subject must adapt himself, the task is *machine-paced*. When the subject can work at his own rate and control the speed of the apparatus, the task is *man-paced*.

A recent study using a pursuit rotor compared the effects of massed and distributed practice on the two types of pacing. For machine-paced work the turntable revolved at a constant speed of 60 revolutions per minute, but during man-paced work its speed depended upon the length of time the subject was able to maintain contact with the target. On each trial the rotor started and moved faster until contact was lost. If the subject held the stylus on the target for an appreciable length of time, the turntable would reach the maximum speed of 60 revolutions per minute. Thus, under machine-paced, the task was extremely difficult from the beginning, while under man-paced it became progressively difficult as skill developed. An earlier study using a man-paced rotor had found that the poorest subject could hold the stylus on the target only when the rotor was stationary or nearly so (Ruch, 1934). Time on target varied considerably for the two conditions, most man-paced subjects maintaining contact for a while even at the beginning whereas the machine-paced subjects lost contact almost immediately on early trials and never maintained contact for as long a time on any given trial. Thus the man-paced subjects spent considerably more time actually practicing the new skill than did the machine-paced subjects.

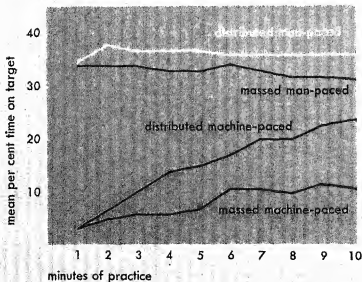
The college students, sixty-nine men and seventy-one women, who served as subjects were divided into four groups: distributed-machine-paced, massed-machine-paced, distributed-man-paced, and massed-man-paced. All subjects worked for a total of ten minutes. For the massed-practice groups, practice consisted of two blocks of five minutes each, with a rest period of one minute between them. The distributed-practice groups were given forty trials of fifteen seconds each, alternating with fifteen-second rest periods.

The men's results are shown in the graph. ▲ Performance started and remained higher for man-paced work, but did not improve during practice, the massed-practice group even showing a slight decrement. All the subjects who were in the more difficult machine-paced conditions improved, however—those with distributed practice making scores approximately twice as high by the end as subjects with massed practice. Incidentally, the men did about twice as well as the women under both conditions of practice (Nance, 1960).

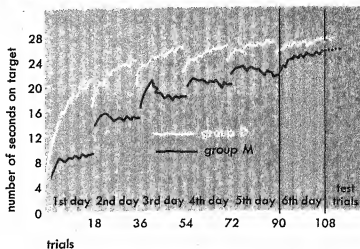
Considerable investigation has been done on the ideal length for rest periods in motor learning. With longer practice periods, longer rest periods are required for highest learning efficiency; with shorter practice periods, the rest intervals can be shorter and the maximum learning rate still be maintained. The optimal length of rest periods for learning different skills is also heavily dependent on the nature of the particular task. Various investigators have shown that the introduction of brief rest periods is especially valuable during the early trials in motor learning.

Psychologists have also investigated whether or not subjects who have learned motor skills under massed practice catch up later with those who have learned by spaced practice.

▲ MAN-PACING, MACHINE-PACING, AND DISTRIBUTION OF PRACTICE



◆ EFFICIENCY OF DISTRIBUTED PRACTICE



In one study using a pursuit rotor task with psychology students, a group given distributed practice (D) was consistently ahead of a massed-practice group (M) during the practice trials on the first five days. At the end of the first five days Group M was at the level of proficiency Group D had attained about two thirds of the way through the series, indicating that the subjects with massed practice had been getting only about two-thirds as much benefit from the practice as the others. The graph clearly shows that there had been more learning per trial under distributed practice.

On the sixth day, the last day of the experiment, both groups were given distributed practice. At the end of that day, Group D had shown almost no further improvement, while Group M was improving faster under distributed-practice conditions. This suggests strongly that the conditions of practice had not influenced the physiological limit but only the amount of practice time required to reach it (Digman, 1959).

Conceptualization and Verbalization in Motor Learning

Studies of human learning have demonstrated that *conceptualization*, mentally picturing the performance of a task, plays an important role in the acquiring of skills which appear to be almost entirely motor habits.

A total of 120 male college physical education students, all right handed, took part in an experiment on

the effects of varying amounts of manual practice and conceptualizing practice on the learning of a novel motor skill. The task consisted of using a wooden paddle held in the left hand to strike a small rubber ball so that it would hit a large target on the wall twenty feet away. Balls were projected out of a tube, one every 12 seconds, at such an angle that the subject had to change the ball's flight 90 degrees in order to hit the target. Each trial consisted of a series of 25 balls.

Subjects were divided into six comparable groups on the basis of their performance on the first trial series. The groups used various combinations of manual and conceptual practice for five practice periods, followed by a test, five more practice periods, and a second test. For the conceptual practice periods, five minutes in length, subjects were asked to concentrate on introspectively rehearsing the sequence of movements required. A written description of these was read by each subject at the beginning of the period. The distribution of kinds of practice for the six groups is shown in the table.

The final mean score for Group A (manual practice only) was slightly higher than that of Group D (alternate manual and conceptualizing practice) but the difference was not statistically significant. Thus the findings support the hypothesis that some conceptualization can help in the acquiring and improving of gross motor skills. The relative amount and placement of it are important, however: conceptualizing with no manual practice at all (Group E) produced little improvement, whereas alternate manual and conceptual practice (Group D) was more effective than a block of either one followed by a block

of the other (Groups B and C). Most interesting of all in its implications for situations where practice facilities are limited was the finding that those who had used the equipment only 40 per cent of the time did virtually as well at the end as those who had used it all the time. The latter group, however, evidently reached a given mean level of proficiency somewhat sooner (Egstrom, 1964).

Verbalization also has been shown to be a valuable aid in human maze learning, a popular laboratory technique for studying the acquisition of motor skills (Warden, 1924; Husband, 1928). On the other hand, though verbalization can help motor learning, it never can take the place of motor practice. This was revealed clearly by the failure of the bridge expert, Eli Culbertson, to play a good game of golf after much analysis and mental rehearsal but no actual practice. It is only by making overt responses and correcting them in the light of feedback that good motor learning takes place. To learn to drive, you must practice driving. To learn to skate, you must practice skating.

Reading vs. Recalling

In reading, you are essentially on the receiving end—taking in someone else's ideas. Your understanding and memory of these ideas may be accurate or inaccurate, clear or hazy. The

SCHEDULES OF PRACTICE AND MEAN TEST SCORES

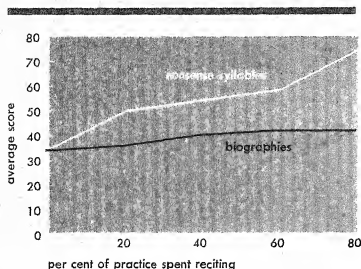
Group	Pretest Mean	Practice Periods					First Test Mean	Practice Periods					Final Test Mean
A	68.15	M	M	M	M	M	101.68	M	M	M	M	M	109.00
B	64.47	M	M	M	M	M	98.00	C	C	C	C	C	99.27
C	65.42	C	C	C	C	C	83.31	M	M	M	M	M	99.42
D	64.85	C	M	C	M	C	90.95	C	M	C	M	C	105.75
E	69.31	C	C	C	C	C	87.41	C	C	C	C	C	94.75
F	69.95	O	O	O	O	O	85.35	O	O	O	O	O	84.81

M=Manual practice

C=Conceptual practice

O=No practice

RECITATION AND LEARNING



Based on Gates, 1928

best way to be sure you have a clear knowledge of what you have read is to close the book from time to time and see if you can reproduce the ideas from memory. As might be expected, studies have shown that time spent in active recitation such as this leads to more effective learning. In one early experiment it was found that when four fifths of the study time was spent in an active attempt to recall, more than twice as many nonsense items were learned. The results were similar but less spectacular with meaningful material (Gates, 1928). ■

The value of recitation is further enhanced when there is some device by which the learner is kept informed as to whether the ideas he is recalling are correct or incorrect.

Whole vs. Part Learning

A learner faced with a large and complex task can go through the whole task from beginning to end and then repeat the cycle, or he can break the whole task into parts and learn each one separately. An enormous amount of research on the problem of which procedure is better has produced no simple answer. Each has its advantages and its disadvantages.

Advantages of part learning. In rote learning, as we saw, short tasks are proportionately easier

to learn than long tasks. Therefore, it is easier and quicker to do rote learning in a series of short sections than to try to learn a long task all at once. This is particularly true in the case of nonsense material.

In the part method the subject gets knowledge of progress sooner, and is thus encouraged. Another advantage is that each part is learned to mastery and then dropped for the moment. This eliminates spending more time than is needed in going over easy parts.

Advantages of the whole method. Since meaningful material is easier to learn than non-meaningful material, anything that enhances meaning helps learning. Here the whole method has the advantage. When the whole task is broken up into parts, the parts frequently become less meaningful because the continuity and the relationships between them are lost.

When material is learned by the part method, the parts must eventually be put together. This makes necessary the additional task of learning the transition between parts. The whole method has the advantage of eliminating this step.

Flexibility of method. As the above considerations make clear, there is no general rule concerning the relative effectiveness of the two methods. In practical learning situations the best results will probably be obtained when the part and whole methods are combined. Go over the whole task a few times to get the advantage of meaning and continuity and to detect the difficult parts. Give these parts extra effort, and then practice the whole task again.

Guidance As an Aid to Learning

What kind of guidance—and how much—helps learning most? This is an important problem for teachers, for too much guidance kills student initiative, whereas too little guidance leaves students to flounder needlessly and waste precious time.

In general it has been found that guidance, when given early, can help establish the correct habits right from the start. Such guidance may include pointing out necessary general princi-

ples and identifying errors. In the learning of motor skills, specific guidance is especially important. It must not be continued too long, however, for the learner must eventually perform the task by himself and should not become overdependent upon cues from others (Hovland, 1951).

The advantage of guidance that points out general principles was demonstrated in a study in which college girls were asked to learn a new alphabet of triangles and other abstract symbols.

Each student received a piece of paper with the symbols printed under the corresponding letters of the ordinary alphabet. One group also received a written account of the principle by which the symbols had been arranged in their particular order. A second group were told that there was a principle, but were asked to discover it for themselves. The third group simply memorized the symbols. In recalling the code alphabet, translating paragraphs written in it, and learning new code alphabets based on similar principles, the students who had been told the principle were slightly superior to those who had to discover it, but not significantly so. The memorization group did much more poorly on all three tasks (Forgus and Schwartz, 1957).¹⁰

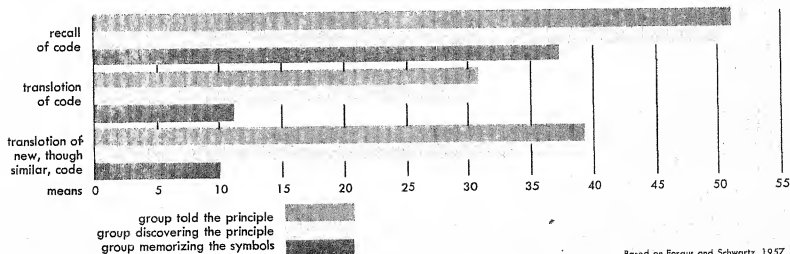
Similar results were obtained in a study with 132 sixth-grade pupils. Their task was to discover the underlying principles involved in the solution of a series of multiple-choice verbal items. Subjects were divided into three groups, one being given a minimum of instruction

in how to answer the questions, the second being given the same instructions plus an explanation of the principles, and the third told ahead of time the clues and even the correct answers, but not the principles. Understanding of the principles was then tested by presenting all the pupils with new tasks where they could be applied. Both two weeks and four weeks after training, the group given the principles made higher scores than did either of the other two groups (Kittell, 1957).

In addition to making certain that students understand underlying principles, the teacher can help them learn by constantly relating new knowledge to what is already known. He must know both the maturational level and the past learning of his pupils to be certain they are ready for new learning experiences and to avoid forcing them into activities for which they are unprepared. Although the teacher initiates new experiences, he can make certain that they will be meaningful by allowing the students to take part in group planning.

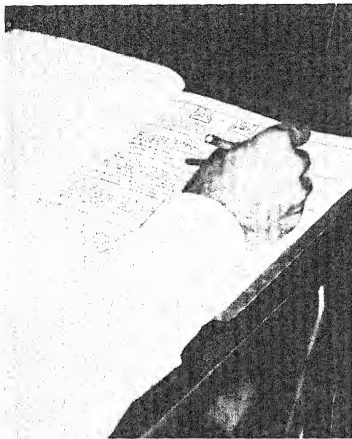
A special form of guidance in learning, which both teaches new material and gives the student a continuing opportunity to check his learning, is called *programed instruction* or, sometimes, *automated instruction*. Whether presented in a machine or via the printed page, programed material breaks the subject matter to be learned into small steps called *frames*. One bit of information is presented at a time, and the student is then asked to answer a ques-

IMPORTANCE OF KNOWING THE PRINCIPLE



Based on Forgus and Schwartz, 1957

◆ In a linear programed text (*left*), the successive frames may go down the same page or may occupy the same position on succeeding pages. Each frame contains the answer to the preceding question, gives additional information, and asks for a response, which the student is to write before going on. When frames are on succeeding pages, the student may work his way through one row of frames to the end of the book, then be directed to turn the book upside down and go back through the next row of frames. In a common form of teaching machine (*right*) the student writes her answer in the window at the right, then turns a knob which moves a transparent screen over her answer and at the same time exposes the correct answer.



tion or complete a statement—perhaps to write a particular word or phrase or to pick the correct one out of three or four alternatives. He is then informed immediately as to whether he was right or wrong. If a machine is being used, he writes his response and then presses a button or lever which moves his answer under a transparent screen where he can see but not change it; at the same time, the correct answer is revealed for comparison. In a programed textbook, the correct answer may be on the next page or in the margin of the same page, with a mask provided to keep the answers covered until it is time to reveal them, one at a time. ◆

A *linear* program, as its name implies, is one that goes in a single line from one frame (information plus question) to the next. Subsequent

frames build on earlier ones and all students go through all frames. Linear programs usually call for “constructed” responses, as in the example below.

“Patterns of accented and unaccented beats form measures. The simplest measures have a two-beat pattern in which the first beat is accented and the second beat is _____. Patterns of accented and unaccented beats form rhythmic units known as _____.” (Dallin, 1966)

A *branching* program, in contrast, usually uses the multiple choice format and provides “side trips” and additional explanations for those who choose wrong alternatives. These explanations tell why the wrong alternatives are

wrong and give additional instruction. In a branching program there may be a paragraph or so of exposition before a question is asked, whereas the linear frames rarely have more than a sentence or so of exposition between opportunities for the learner to make a response. Below is a frame from a branching program designed to teach bridge (Goren, 1960). This program is in the form of a "scrambled book," in which each page contains one frame. In using a program of this type, the student turns to the page indicated next to the answer he has selected. If his answer is correct, the page to which he is referred contains the next step in the program. If he is incorrect, he is referred to a page where he finds an explanation of his error and is told to go back and try the question again.

"The dealer begins the deal by removing the top card from the deck and placing it on the table in front of the player to his left. He continues dealing one card at a time to each player around the table in a clockwise direction. He deals the entire deck of cards, and if he has dealt correctly, the last card will fall to him. Each player now picks up his thirteen cards and arranges them in his hand by suit and rank. This is his *hand*, and he holds it so that it cannot be seen by either his opponents or his partner.

"Cards are distributed by *dealer* as follows:

"Three cards at a time, three times around, then four cards the last time around. page 4

"One card at a time to each player, beginning at dealer's left and continuing in a clockwise direction around table. page 10

"One card at a time to each player, beginning at dealer's right and continuing in a counterclockwise direction around table. page 23"

A vast amount of research is in progress using different subject matter and different combinations of the programed material with lecture, discussion, TV, and other forms of teaching, with learners of all ages. In industry and in military settings, where a high level of motivation is assured, programed training manuals have shown considerable utility. In the school setting, results have been more varied and more contradictory.

It is too early to say what the ultimate role of programed instruction in the public schools will be. Experimental results suggest that programed learning requires a great deal less time than conventional methods, often taking only about half the time spent in covering the same material by ordinary classroom techniques. Moreover, what is learned appears to be retained as well as that learned in the conventional manner, provided, of course, that adequate review is included in the program. In the classroom, programed instruction seems most helpful (1) when it involves subject matter in which there is a logical progression of ideas, with later concepts dependent on the mastery of earlier ones; (2) when it is used to provide a common background for all the members of a class so that class time can be spent on more advanced and creative exploration; and (3) when it is used in connection with a good text and an excellent teacher.

LEARNING UNDER SPECIAL CONDITIONS

There has been a great deal of popular interest in the question of whether learning will come more easily under certain special conditions—while the learner is asleep, say, or under hypnosis. Psychologists have found that

while some conditions thought to promote effortless learning really do help, others are ineffective. It has also been found that there are special conditions which interfere with the learning process.

Hypnosis

An interesting but inadequately explored possibility for increasing learning efficiency is the use of hypnosis. Most investigations of learning under hypnosis have involved conditioning. During hypnosis a stimulus and a response are paired a few times. For example, the hypnotist may touch the subject's arm while the subject is coughing or may snap his fingers while the subject is smelling camphor. After the subject is awakened, amnesic for the conditioning process, he will cough or show a tendency to do so if his arm is touched, or, if the experimenter snaps his fingers, the subject will wonder why he suddenly smells camphor in the room.

Studies of more complex learning processes during hypnosis are rare.

One early experimenter had subjects learn nonsense material and compared their rate of learning under hypnosis with their rate of learning when not hypnotized. He found that during the first few trials, the rate of learning was faster in the hypnotized state but that in the later trials the rate was almost identical. There was no significant difference in total performance (Strickler, 1929).

A much more recent experiment investigated the effect of hypnosis on the learning of the Morse code. Subjects who learned the code under hypnosis made fewer errors in subsequent tests (all conducted in a waking state) than did subjects who learned the code without being hypnotized. The difference between the two groups was still significant on a test given 30 hours after learning (Sears, 1955).

Another experiment altered the subject's sense of time under hypnosis and then tested his learning performance. An individual's sense of time can be so distorted by suggestion under hypnosis that a period of seconds will seem to be many minutes.

A standard learning experiment was arranged, using pairs of nonsense syllables printed on cards. In the first part of the experiment, 150 pairs (five pairs at a session) were shown to the subject and read to him slowly. Then he was allowed to print the letters five times and study them. This took about 26.5 seconds per pair. After a set of five cards was studied in this way, learning was

tested by having the experimenter shuffle the cards and then read the first item of each pair, with the subject giving the second item if he could. Then the card was shown to him again, and he was allowed to study it for 5 seconds. This process was repeated until he could give the second group of each pair perfectly.

Next the subject's sense of time was altered under hypnosis and the experiment was repeated with a new series of cards. In this case the subject closed his eyes, printing the letters only in his imagination. He was allowed only 5 seconds per pair instead of the 26.5 used while he was awake. Under hypnosis, he was able to master the word pairs in less than a quarter of the time it had taken him to learn equivalent material when awake, and the learning seemed easier and more leisurely. Tested after twenty-four hours, the subject had retained a greater proportion of the materials learned under hypnosis and could relearn forgotten material in less time (Cooper and Rodgin, 1952). Similar results have been obtained more recently in a study in which subjects memorized series of digits (Zimbardo, Rapaport, Dworkin, and Baron, 1965).

One interpretation of such findings is that hypnosis is an extreme state of focused attention, free of the external and internal distractions that often interfere with concentration. Several unexplored factors are involved, and more experimentation is needed before conclusions can be drawn about the place of hypnosis in improving learning efficiency.

Subliminal Stimulation

Claims have been advanced that people can become conditioned to stimuli that are too faint to be consciously perceived. Such stimuli are called *subliminal*, meaning that they are below the psychophysical threshold, or *limen* (see Chapter 8).

In one study the threshold was defined not as a single point or intensity (loudness) level, but as a range between the lowest intensity level which the subject could consistently hear and the highest intensity level that he did not report hearing in five successive trials. Ten male subjects of normal hearing were used in the experiment. Threshold determinations were made in a room so quiet that nothing could be heard but breathing and heartbeat, both clearly audible. Frequencies ranging from

200 to 20,000 cycles per second were used. Because it can be accurately recorded and has been proved to be readily conditioned by stimuli above the threshold, the galvanic skin response (GSR) was used as the response to be conditioned. This is a change in the electrical properties of the skin (see p. 424). The unconditioned stimulus was a mild electric shock applied to the subject's ankle. The conditioned stimulus (subliminal sound) was presented for five seconds, during the last half-second of which the unconditioned stimulus was presented. There was no evidence of conditioning to sounds presented at this subliminal level (Wilcott, 1953).

In another study an attempt was made to induce conditioning to subliminal visual stimulation in the form of response words flashed on a screen during paired-associate learning. Again no conditioning was achieved (Vernon and Badger, 1959).

An earlier study had seemed to give more positive results. Here students were told they were taking part in an experiment on clairvoyance. Actually, reflections of cards bearing familiar forms were being projected onto a mirror surface at low intensities. Although the illumination remained so low that the subjects thought no visual stimuli were present, their guesses improved under conditions of praise for right answers and mild shock for wrong ones (Miller, 1940).

These experiments, taken together, give us a clue to the nature of the confusion that has entered the psychological literature on learning without awareness of stimulation. In the first two experiments the presentation of subliminal stimuli produced no measurable effect. In the experiment with cards it is not easy to be sure there was no perception; possibly there was an awareness of some fragment of the complex stimulus pattern but not enough for the subjects to be certain. Thus they may not have been guessing completely, even though they thought they were.

A more recent experiment lends support to this conclusion.

In this study of verbal conditioning, subjects were asked to say any words that came to their minds. Whenever a subject said a plural noun, the experimenter said "Mm hmm." As the experiment proceeded, there was a significant increase in plural nouns. None of the subjects were able to say what the "correct" response

category was, but those who realized that the "Mm hmm" indicated a correct response were the only ones to show evidence of learning. These subjects had the clue of knowing that they should continue to give words in some way like the word they had just given, although they did not know that the category was plural nouns. Thus they were not completely without awareness (Dulany, 1961). Similar results have been obtained in a more recent study (Dean and Hiesinger, 1964).

In another recent study similar procedures were employed, but nouns denoting a person or persons, such as *architect*, *girl*, *Protestants*, etc., were reinforced. Afterwards, the subjects (eighty-two college girls) were given an opportunity to write down any thoughts they had about the experiment. These comments indicated that a number of subjects never "caught on" to the purpose of the experiment. One even wrote, "Oh, for heaven's sake, why didn't you say you wanted names of people. I thought you were clearing your throat." Others, however, expressed clear awareness of the relationship between the reinforcement and their responses. Only those subjects who were aware of why the experimenter said "Mm hmm" showed an increase in the number of human nouns spoken. The performance of unaware subjects did not differ significantly from that of the control group, who had had 10 per cent of their responses reinforced on a random basis (DeNike, 1964).

At the close of her session, each subject was interviewed in an effort to discover the extent to which she had wanted the reinforcement and tried to get it. Of the aware subjects five wanted and tried for the experimenter's "Mm hmm," thirteen did not want it but tried, and two did not want it and did not try to get it. The performance of these two stayed essentially at their initial level. Those who both wanted reinforcement and tried to get it showed the greatest increase in "human" nouns, although those who tried without especially wanting the reinforcement also gained (DeNike, 1965).

Experiments such as those just cited suggest that it is highly unlikely that truly subliminal stimulation will ever be important in teaching, psychotherapy, advertising, or political campaigning.

Sleep

For a time there seemed to be some hope of utilizing an individual's sleeping time for fur-

thering his education, since certain studies had suggested that learning might occur during sleep (Fox and Robbin, 1952; Leuba and Bate-man, 1952). More recent studies, however, have shown less favorable results.

One pair of investigators felt that the inconsistency in the results of the sleep-learning experiments could be attributed to inadequately controlled variables in those studies that showed favorable results. They suggested that if learning *did* occur during the night, it probably took place in a partial waking state which the subjects did not recognize or recall. To test this hypothesis, they decided to make absolutely certain that their subjects were fast asleep. It is now possible to study the activity of the brain directly, by measuring the changes in certain minute electrical oscillations given off by the cerebral cortex. These rhythmic electrical "beats" are recorded by an instrument called an *electroencephalograph* (EEG), which is connected with electrodes placed on the scalp. The EEG pattern is very different at different levels of sleep. The waking pattern is characterized by the "alpha rhythm"—a beat of about ten oscillations per second, which disappears as the subject goes to sleep.

The experimenters attached the EEG electrodes to the subjects in such a way as to cause them no discomfort. The tape-recorded learning material—ten one-syllable nouns—was played through loudspeakers in the booths where the subjects slept. Each EEG was continuously monitored, and the material was played only when alpha frequencies had been absent for thirty seconds. The tape recorder was turned off whenever the alpha frequencies reappeared or any muscle movement was observed.

In the morning the subjects were asked to select the ten nouns in the learning material from a list of fifty nouns. The same list was shown to a control group who were told that they were participating in an experiment on extrasensory perception and were asked to identify ten words the experimenter had chosen. The subjects who had heard the words while asleep did not choose a significantly greater number of correct words than did the controls (Emmons and Simon, 1956). Thus learning did not occur when the factor of depth of sleep was adequately controlled. In two other studies, too, in which the subjects were actually watched during the experiment and the material was presented only while

they were clearly sound asleep, there was no evidence later of learning during sleep (Hoyt, 1953; Stampf, 1953).

Radiation

In this age of nuclear power, it is particularly important to know how radiation affects learning, and a number of experiments investigating the effects of radiation have been performed on animals. Rats irradiated during the fetal period and tested as adults have been shown to be markedly inferior to normal adult rats in learning (Levinson, 1952).

To test the hypothesis that the early weeks of life are a crucial period for radiation damage to learning capacity, one experiment studied rats irradiated between birth and the age of three weeks.

In this study, eighty-two experimental subjects and nineteen controls at seven age levels were used, and four levels of radiation dosage were tested. To determine what effects different radiation levels had had on rats of various ages, all the rats were tested at the age of forty-five days on a maze, and at eighty-five days they were given other laboratory problems. Rats irradiated during the first four days of life showed the greatest learning deficits, while those not irradiated until the age of eighteen or more days did not differ significantly from the control animals. Radiation dosage also proved to be a significant variable—whether learning was measured in terms of number of trials required to learn the maze, number of errors, or length of time required. Performance on both the maze and the later tasks declined rapidly in proportion to the radiation dosage (Levinson and Zeigler, 1959).

By the age of three weeks, the rat's nervous system apparently has become relatively resistant to radiation, and in adulthood it is able to withstand doses which would severely damage many other body tissues. Experimenters have found that neither six-month-old rats (Arnold, 1952), nor adult monkeys (Davis, McDowell, Deter, and Steele, 1956) show appreciably worse learning when tested on mazes and other laboratory tasks after receiving large doses of radiation.

ABILITY TO LEARN AND REMEMBER

If we are to manage our learning experiences successfully, it is important that we know as much as we can about our ability to learn and remember, about the possibility of increasing it through our own efforts, and about what changes in it we can expect as we grow older.

Is There an "All-round" Ability to Learn and Remember?

In an age of rapidly changing technology, which demands the acquisition of new knowledge and skill as a measure to prevent unemployment, it is clearly important to know whether or not learning ability is specific to particular kinds of tasks or situations. Until recently, most available evidence had not indicated a general learning factor. If there were such a thing, we would expect to find high intercorrelations among performance scores on different kinds of learning tasks. But most studies have found such intercorrelations to be low (Husband, 1939). Nor has the technique of factor analysis indicated any general learning capacity (Woodrow, 1940; Heese, 1942).

Failure to find evidence of general learning capacity in these studies may result from the way the experiments are usually designed. The conventional measure of gain from learning is defined as the difference in performance between the beginning and end of practice. But such a definition of gain is almost certain to give an incorrect measure of learning capacity, since the original measures reflect *both* capacity and whatever prior unrecorded experience the subject may have had with such tasks. The higher his capacity and the greater his previous practice, the better the subject's initial performance will be and the less room he will have for further learning. Thus a subject with *less* learning capacity might even show *more* learning during the practice session, simply because there is more left for him to learn. It follows, then, that a factor analysis based on such data probably would not reveal a general learning

factor, even if such a factor did exist. By the use of statistical methods of greater sophistication which control for this discrepancy in initial status, some evidence of a general ability has been obtained (Ruch, 1936; Manning and DuBois, 1962; Duncanson, 1966).

Another approach has investigated the possibility that there may be ability *factors* common to different kinds of learning tasks.

Twenty-seven memory tests and thirteen aptitude tests were given to 442 air cadets and a factor analysis made of the data. The materials, some presented visually and some auditorily, included numbers, letters, nonsense syllables, limericks, stories, pictures, and designs. The following kinds of memory were revealed: (1) rote, the recall of meaningless material; (2) *meaningful*, the recall of meaningful material; (3) *span*, the recall of a series of unrelated items presented only once. Whether the materials were presented by sight or sound, the same capacity was required. The meaningful memory ability was the same for both verbal and nonverbal materials (Kelley, 1954).

Do Slow Learners Remember Better?

We have all heard someone say, "I'm slow to learn, but I never forget." Contrary to popular opinion, however, the slow learner does not remember better than the fast learner. Although it might appear that slow learners, because they go over the simpler parts of a task so many more times, would recall them better than the fast learners, this hypothesis was not supported in a recent study.

Elementary school children learned to associate geometric figures with numbers and were then divided into groups on the basis of how fast they had learned. After twenty-four hours they were required to relearn the material. The fast group took fewer trials to relearn and made fewer errors than did the slow group (Gregory and Bunch, 1956).

There is a considerable body of data consistent with these findings, starting with a study that

was published over seventy years ago (Calkins, 1894).

Can Ability Be Increased Through Learning?

We can learn not only how to do or say specific things but also *how to learn*, and this kind of past learning is important in determining our ability to learn at any given time. This fact was clearly demonstrated in an experiment which is considered a classic.

College students were given sixteen lists of nonsense syllables to learn to the point that each syllable could be spelled correctly before it was exposed on a memory drum. The lists were equivalent in difficulty, and in the similarity of the items to each other within the list. The results are clearly seen in the graph. ■ The number of trials required to learn the final lists was about one half as great as that required to learn the first list (Ward, 1937).

Learning to learn is even more pronounced with highly meaningful material. For example, you have undoubtedly learned a great deal about how to learn college subject matter in the most efficient manner. Perhaps you have learned how to organize and categorize new ideas and distinguish between central points and subordinate ones. Undoubtedly you have also learned certain basic concepts in introductory courses that you have used and built upon in more advanced courses. Without these basic concepts and general study skills, you probably would not have had the ability to master the advanced work, however good your genetic potential.

Psychologists would say you have been forming *learning sets* which enable you to learn more rapidly and understand more advanced material. In recent years, systematic studies of the formation of learning sets have been made with both animal and human subjects.

A series of ingenious studies by Harry Harlow first demonstrated this kind of learning.

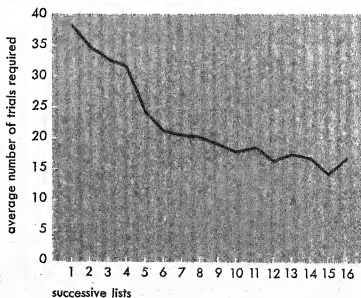
In these studies monkeys were presented with a series of problem situations in which the principle was always the same but the specific material was varied. In each problem two geometric forms were presented. A reward

was always hidden under the same one, but the position, size, and color of the forms were varied. When one problem was mastered, a new problem with different forms was presented. Altogether 344 problems were used.

In the early problems several trials were necessary for mastery, but by the 257th problem the monkeys had apparently learned the general rule; if they picked the wrong form on the first trial, they picked the right one on the second trial and consistently thereafter 98 per cent of the time. A comparison of the shapes of the two learning curves shows the monkeys' increased ability to solve problems of this type. ■ On the early problems the usual learning curve was obtained, showing gradual learning over many trials; on the later problems the subjects needed only one trial to discover which item of each new pair was the correct one. (The learning curves start at 50 per cent correct responses because prior to learning there would be as many correct responses as errors just by chance.)

Following this series learning-set formation on more complex problems was tested by putting the same monkeys through a series of 112 discrimination reversal problems. In each of these, a discrimination problem was presented for 7, 9, or 11 trials; these were followed by 8 more trials in which the previously correct stimulus became the incorrect one and vice versa. By the 70th problem and thereafter, performance on the second reversal trial

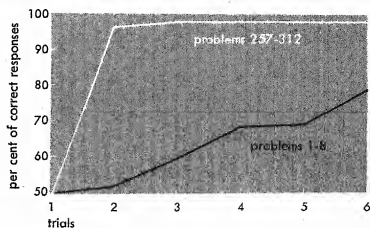
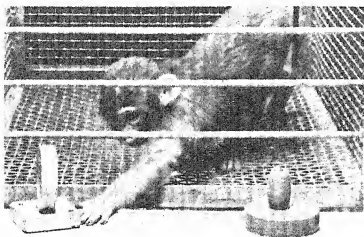
LEARNING HOW TO LEARN



Based on Ward, 1937

THE ESTABLISHMENT OF LEARNING SETS

The photo shows Harlow's apparatus and the kind of geometric forms used in the problems. The graph contrasts the learning curves for early and late problems.



Based on Harlow, 1949

was 97 per cent accurate. Thus, not only were the animals performing as well as they had on the original problems, but they had formed the new learning set for reversal more rapidly than the original one, even though it was more complex. Evidently the monkeys were learning how to learn learning sets (Harlow, 1949).

A similar pattern of learning-set formation has been found in children of nursery-school age, in studies using beads or toys as rewards—although children, of course, are quicker than monkeys to learn the important relationships. Previously acquired learning sets tend to become increasingly important as the learning task becomes more complicated.

A recent study with seventh-grade subjects sought to analyze the influence of previously acquired learning sets on speed of mastery in a course on equation solving.

In this study it was discovered that a subject's ability to learn to solve linear equations depended primarily upon how well he had acquired a whole hierarchy of learning sets. This hierarchy was revealed by asking, "What would an individual have to know how to do in order to perform this task?" In order to multiply, for example, he would need to know the multiplication table. Before that he would need to know how to read numbers and multiplication signs, have concepts of "five-ness," "eight-ness," and so on.

This study found a consistently high relationship between success on relevant subordinate learning sets and on higher learning sets. As the subjects progressed from the bottom to the top of the hierarchy, their rate of learning new sets depended increasingly on the learning sets previously acquired and decreasingly upon basic ability factors (Gagné and Paradise, 1961).

These findings show that, as material to be learned becomes more complex, the rate of learning depends increasingly upon whether the individual has previously built up the necessary subordinate sets or must acquire them all in the current learning situation. The more learning sets he has in his repertoire, the greater his ability to tackle complex problems.

How Does Learning Ability Change with Age?

Teachers, students, and parents are all interested in knowing at what age one should attempt to learn certain things in order to achieve maximum returns on a minimum investment of time and effort. And since social statistics show that the proportion of elderly people in our population is continually growing, it is becoming increasingly important to investigate the extent to which aging affects the ability to learn.

In general, studies with many kinds of learning tasks have shown that the quality of learning performance increases during childhood and up to maturity, but that after this time both speed and accuracy of learning decline. Part of this change with age may be attributable to factors other than learning capacity. For example, during childhood and adolescence a growing background of experience undoubtedly contributes to improved performance, whereas in old age a poor score in learning or recall may reflect poor motivation or a decrease in visual acuity or motor coordination (Hovland, 1951).

The exact course of the rise and fall in learning performance seems to depend on the nature of the material to be learned.

In a series of experiments, a group of subjects aged about twenty and another group over sixty learned two motor and three verbal tasks. One of the motor tasks was learning to perform a coordinated movement of the right hand while looking directly at it. The other motor task was learning to perform the same type of movement when the hand was seen in a mirror. Notice that in the first of these tasks the habits of a lifetime were useful—many of the basic elements of the required movement had been practiced in random fashion through daily manipulation of objects. In the second task, however, old visual habits would actually interfere. Before the mirror-vision habit could be established, the old direct-vision habits had to be overcome. The results showed quite clearly that the older learners were more handicapped than the younger ones in this mirror-vision learning task.

The three verbal tasks showed comparable results. The tasks were the following:

1. Associating meaningful pairs of words, such as horse-sheep.
2. Associating nonsense materials, such as $F \times P = V$.
3. Associating interference materials, such as $2 \times 4 = 9$.

In each case the subjects learned to give the second member of the pair upon seeing the first. Notice that the meaningful words can be grouped by some logical principle—both words in the example are names of animals that eat grass. But the nonsense materials are purely arbitrary; $F \times P$ could equal V or it could equal anything else. The third pair, the interference material, is so labeled because old verbal habits interfere with learning. We are so used to thinking and saying 8 when we see 2×4 that it is very hard to learn to say 9.

On all three tasks the young group was superior to the older one. The differences were least for the mean-

ingful pairs of words and greatest for the interference materials. Again, performance on tasks in which prior learning was an aid showed a smaller decrement with age than performance on new tasks which conflicted with older habits (Ruch, 1934).

Several other factors in the intellectual decline of the aged were investigated in a more recent study which used subjects of at least high-average intelligence.

Two hundred subjects were divided into three age groups matched for general intelligence, vocabulary, and social background as measured by education and occupational history. Group A consisted of persons aged 17 to 35; Group B, 36 to 55; and Group C, 56 to 74. Their performances were compared for several different types of learning.

Ability to repeat digits spoken by the experimenter did not decline appreciably with the age of the group, but the older group did more poorly than the younger groups in repeating digits backward. Their visual memory was even more impaired, as shown by a test in which they looked for one minute at a card containing ten geometric shapes and then tried to identify those ten on a card containing twenty shapes. There was also considerable age decrement in incidental, or latent, learning—the ability to notice and remember things which are not immediately relevant to the task in hand.

In tests of rote learning of nonsense syllables, it was found that all groups were equally subject to the serial position effect [greater ease in recalling early than later items in a series and greatest difficulty of all with those just past the middle of the list]. The men's performance on rote learning did not decline until the late sixties, whereas some decrement was seen in the women as early as the forties. Except for this earlier decrement of the women in rote learning and a decrement of Group B as a whole on the incidental learning tasks, the differences between Groups A and B were slight (Bromley, 1958).

A slightly different approach to learning and aging was made in another recent study of short-term retention of rapidly changing information.

The apparatus consisted of twelve telegraphic keys, numbered 1 to 12, with lights directly above them, also numbered 1 to 12. Light moved from key to key at a fixed speed and a buzzer sounded when a correct response

was made. Keys were pressed under four conditions: (a) no-back, in which the subject pressed the key where the light appeared; (b) one-back, in which he pressed the key where the light had just gone out; (c) two-back, in which he pressed the key where the light had been three positions before; and (d) three-back, in which he pressed the key where the light had been three positions before. Subjects included twenty persons aged 60 to 84 and twenty aged 18 to 24 (ten sailors and ten college psychology students).

The elderly subjects did about as well as the young ones in the no-back condition, showing that they were able to keep up with the physical movement of the light. However, they showed a serious decline in performance under the other conditions. • While the students made a mean of 36.00 correct responses on one-back (the same as their no-back mean), older subjects made a mean of only 29.33 correct responses. Under two-back conditions, the elderly group made only 12.58 correct responses as compared to 32.90 for the students. Furthermore, only about half of the total number of key pressings made by the elderly group on two-back were correct, as against 90 per cent of those made by the sailors, who were slightly less efficient than the students. Older subjects tended to omit many responses altogether under the more complex conditions, whereas younger ones usually managed to respond, even if inaccurately. When given more time for the two-back condition, four older subjects approached the scores made by the younger ones in the regular length of time allowed. Since the elderly subjects had shown ability to keep up with the light physically, the differences apparently reflected ability to retain and organize information about the light (Kirchner, 1958).

Similar results were obtained in a study involving ability of elderly people to perform a pursuit tracking task after the course had disappeared from view.

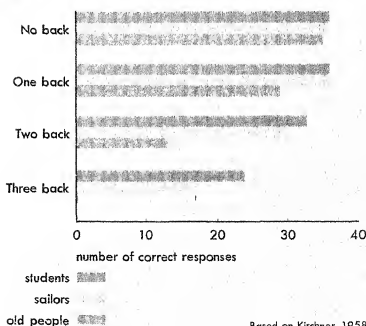
The apparatus consisted of a box with a window showing a moving paper on which the course was marked. The subject was to follow the course with a pen which he moved by means of a wheel at the bottom of the apparatus. The older subjects (aged 46 to 56) did about as well as the younger ones (aged 21 to 28) when the course remained in view all the time and moved at a speed of 4.5 centimeters per second, but made more errors when the speed was increased to 9 centimeters per second. The difference in performance between young and old was much greater when the course was masked

from time to time so that subjects had to follow it as they remembered it. Errors for both age groups increased as the amount of information which had to be stored increased, but the increase was more severe for older subjects (Griew, 1958).

Since the ability to learn and remember is an important part of general intelligence, the many broader studies of age changes in intelligence are also relevant here and cast further light on how learning ability can be expected to change as we grow older. It seems that there is no reason why older people should give up trying to learn new skills and gain new knowledge. Many people look forward to retirement from active business or professional life as an opportunity to pursue interests that they have had to neglect during their working years. In general, if the elderly person is sufficiently motivated, he will not be disappointed in his progress as long as the new skills he tries to learn are not in conflict with older ones.

The decreased ability of older people to acquire knowledge, skills, and attitudes that are inconsistent or antagonistic to what they have previously learned and practiced, may help to account for the well-known fact that people tend to become conservative or even reaction-

LEARNING ABILITY AND AGE



Based on Kirchner, 1958

ary as they grow older. Although our society is rapidly changing, both in technology and in prevailing economic philosophy, requiring new attitudes and skills, it can be predicted that an aging businessman will come more and more to

react to new problems on the basis of knowledge, skills, and attitudes learned in his youth. Thus a certain degree of conservatism would appear to be part of the biological and social heritage of mankind.

WHAT MAKES US FORGET?

If learning had no lasting effect, the organism would have to "start over" with each new stimulus situation. Often, indeed, we are disappointed at the amount we *do* forget. "Knowing" something right after practice is no guarantee that we will know it a month or a year later. Psychologists have, therefore, given a great deal of study to the conditions influencing retention and forgetting.

There is much evidence that forgetting is not merely passive decay which occurs over a period of time when a habit is not practiced or used. Indeed, as we shall see, some studies indicate that forgetting is not inevitable, even during a period of disuse, and that when it does occur it is a function of several factors. Many of these factors can be controlled, either directly or indirectly, by learner and teacher.

Inadequacy of Original Learning

Often material is forgotten simply because it was only partially learned. If you study something only long enough to get a vague, general idea about it, you cannot expect to remember it as well as if you have a clear understanding of it. Such an understanding includes both grasping the parts individually and, equally important, seeing their relationships to each other. In fact, organizing the material into a summary outline, with major points and subordinate points, and then memorizing this outline will greatly aid subsequent retention as well as retrieval of the material on examinations. It is

also important not only to be able to *recognize* correct statements about the material, as on a multiple-choice test, but also to be able to *recall* it. Recall, as we have seen, requires a higher degree of learning than recognition. If you can recall the material unaided, you are more likely to remember it later.

Even when recall is letter-perfect, there is still something more that can be done to promote good retention. Many studies have shown evidence that *overlearning* a task—that is, continuing to practice it even after a completely correct performance has been achieved—will greatly aid later retention of the material.

The Importance of Review

In order to maintain a high level of mastery after learning, it is important to review as soon as possible after learning and then to review again from time to time. Review should be selective, with the most emphasis given to those parts of the material which are most important or most difficult.

If a person has an equal degree of mastery over two sets of material, one learned before the other, the material learned earlier will be remembered better in the future and can be maintained at the same level of mastery with less review (Woodworth and Schlosberg, 1954; Youtz, 1941). From a practical standpoint, this means that mastery of subject matter becomes more stable the longer it is maintained, requiring less and less review.

Interference from Later Activity

We have seen that previous activity can either inhibit or facilitate new learning. In much the same way, the activity that *follows* learning can either hinder or help remembering. This backward-working influence is called *retroactive inhibition* or *retroactive facilitation*, depending upon whether the intervening activity hurts or helps.

Waking vs. sleeping. If the interval following learning is spent in ordinary waking activities, there is usually more forgetting than if the same length of time is spent in sleep (Jenkins and Dallenbach, 1924). This finding suggests that forgetting is brought about more by the destructive effect of other activity than by the mere passage of time. The forgetting found in one study of sleeping and waking is shown in the graph.

Effects of new learning. As might be expected, some kinds of waking activities, particularly learning activities, interfere more than other

kinds with the retention of material just learned.

In one experiment all the subjects began by memorizing a list of adjectives. After a ten-minute interval, all were tested for retention of the list.

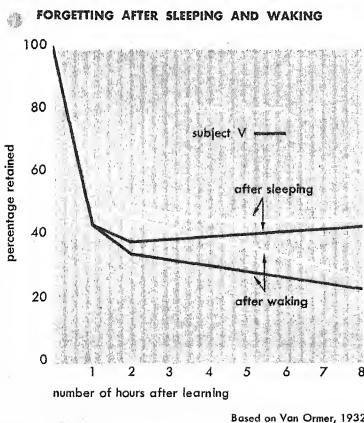
The ten-minute interval between learning and testing was spent in a different manner by each group of subjects. One group learned a second list of adjectives composed of synonyms of those in the first list; another learned a list of adjectives that were antonyms of the original words; a third group learned a list of adjectives unrelated to the original list. Another group of subjects learned nonsense syllables, and still another used the interval to memorize a list of three-digit numbers. A sixth group rested. The table below shows how well each group did when tested for retention of the original list of adjectives.

Material learned in interim	Per cent of the original list recalled
Synonyms	12%
Antonyms	18
Unrelated adjectives	22
Nonsense syllables	26
Numbers	37
Interval of rest	45

The amount of retroactive inhibition, as shown by poor recall, was in direct proportion to the similarity between the original learning and the interpolated activity (McGeoch and McDonald, 1931).

A recent study shows that the same effect holds for verbatim learning of meaningful material.

Twenty-eight college psychology students served as subjects. Following a preliminary practice period each subject was given four experimental sessions. At each session the original learning material consisted of a twenty-word sentence dealing with semantics. After this was learned, the student learned an interpolated passage, following which he was retested on the original sentence. A high-similarity interpolated sentence dealt with semantics, an intermediate-similarity sentence with mathematics, and a low-similarity sentence with government. All were equated with the four original sentences for difficulty of learning. In a control session, no interpolated material was learned, but the student was kept



busy at a color-guessing task to prevent him from rehearsing the original sentence. Retroactive inhibition was greatest when interpolated material of high similarity was used and least when low similarity material was used (Slamecka, 1960).

Experiments have shown consistently that the important factor in interference is the *similarity* between the original learning and the interpolated activity—irrespective of the nature of the material. Many studies have shown that the thoroughness with which the interpolated material is learned also affects retroactive inhibition: the more thoroughly the new material is learned, the more it will probably interfere with the material previously learned (McGeoch, 1929; Underwood, 1945). In one study involving a digit-learning task, however, merely reading a second set of digits interfered with retention of original learning as much as memorizing them (Sanders, 1961). Apparently any intake of new information is potentially interfering even when there is no intent to learn.

The thoroughness of learning of original material is also a factor. As might be expected, less well learned material is more vulnerable to interference from subsequent activity.

Meaningfulness and Forgetting

There is ample evidence that meaningful organization in the learned material decreases the amount of forgetting, irrespective of the type of activity that follows.

In a study of the forgetting of meaningful material, subjects read short stories which had been constructed to contain twelve items that were essential to the plot and twelve items that were not. The subjects read each story at a different time of day and were asked to recall it approximately eight hours later; the intervening period between reading and recall was spent sometimes in sleeping and sometimes in waking. The material recalled by each subject was scored independently by three different judges, with the following results:

Material	Percentage Recalled	
	After waking	After sleeping
Essential	86	87
Nonessential	23	47

It is evident that under both conditions a much greater percentage of the essential material, as compared to nonessential, was retained. The degree to which essential material was forgotten did not seem to be influenced significantly by the conditions of sleeping or waking, whereas the recall of nonessential material was twice as good after sleeping (Newman, 1939).

Apparently nonessential elements, like nonsense materials, are more vulnerable to interference from intervening activities than are elements that are an integral part of a meaningful whole.

A later experiment has shown that the method of measurement affects the relationship found between the degree of meaningfulness and the amount of retention.

In this experiment the rate of the original learning was directly related to meaningfulness, as would be expected. On tests of retention one day and seven days later, however, there was a significant advantage for meaningfulness when the recall method was used but not with the method of relearning (Dowling and Braun, 1957).

All these findings have definite practical applications. In scheduling learning periods a student should remember that much forgetting seems to result from the interference effect of ensuing activity—especially of similar activity. If possible, therefore, two similar subjects, like Latin and French, should not be studied one right after the other. In learning important material, it is well to follow a study period with an entirely different activity or with rest. And because meaningful, organized material tends to resist retroactive inhibition, a student should try to make what he learns as meaningful as possible—especially lists, series of facts, or verbatim material of any kind. This means trying to get an overall picture of the material to be learned and relating it to previously acquired knowledge.

Emotional and Motivational Factors

Tasks that are interrupted before completion are more likely to be recalled than tasks which have been completed. This phenomenon is

called the *Zeigarnik effect* after the Russian psychologist Bluma Zeigarnik, who first demonstrated it experimentally.

In this classic experiment the subjects performed simple tasks which they would be able to accomplish if given enough time, such as writing down a favorite quotation from memory, solving a riddle, and doing mental arithmetic problems. In some of the tasks the subjects were interrupted before they had a chance to carry out the instructions in full. In others they were allowed to finish.

Despite the fact that the subjects spent more time on the completed tasks than on the interrupted ones, they tended to recall the unfinished tasks better than the finished ones when they were questioned a few hours later. This superiority of recall for the uncompleted tasks disappeared, however, within twenty-four hours. Apparently it was attributable to short-term motivational factors rather than to a difference in the actual learning of the two sets of tasks (Zeigarnik, 1927).

More recent evidence indicates that the Zeigarnik effect applies only to memory for tasks performed under nonstressful conditions. When the individual performs a series of tasks under conditions where noncompletion threatens his self-esteem, there is a tendency for the Zeigarnik effect to be reversed—that is, for completed tasks to be remembered better than noncompleted ones (Alper, 1952).

Clinical evidence indicates that very painful experiences are more difficult to recall than pleasant ones. People *do*, of course, remember many unpleasant experiences. But when a particular memory threatens the individual's self-esteem, it may be pushed out of consciousness—a process called *repression*. The following case affords a clearcut example of this.

Two girls about twelve years old had been placed by their parents in a house of prostitution under circumstances that were almost unbelievably degrading. When this situation became known and the girls were encouraged by the authorities to tell their story, they gave highly detailed information which was quite adequate to incriminate their parents and the other people responsible.

But when the girls were questioned again several months later, they omitted many of the factual details—

even those concerning some of the more drastic parts of their experience. When their earlier testimony was summarized for them, they denied with apparent sincerity that such things had ever happened and said indignantly that the stories must have been made up to discredit them (Erickson, 1938).

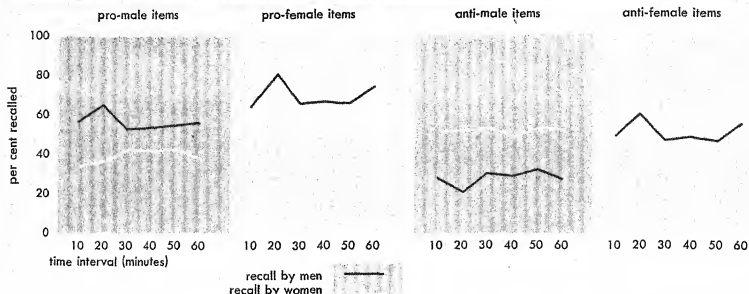
In a case like this where the original experiences had been so vivid and so emotionally significant, we would expect retention of the facts to be easy. But, as we shall see in Chapter 13, repression often acts as a self-protective device, tending to make the person "forget" such painful experiences. We shall also see, however, that repressed material usually stays active at an unconscious level and may produce emotional conflicts.

What happens with the little experiences of daily life which are only *slightly* unpleasant? Is there any tendency for them to be forgotten more quickly than pleasant experiences? Although the evidence is conflicting, it seems to indicate that, in general, pleasant memories show a stronger tendency to persist than unpleasant ones and both are better retained than neutral ones (Gilbert, 1938).

With controversial material, the degree of retention is related to the individual's attitudes toward the subject. People have a tendency to learn material faster and remember it better when it agrees with their own attitudes than when it contradicts them (Levine and Murphy, 1943).

A 350-word passage dealing with the advisability of admitting women students to a male university and containing a number of pro-male, pro-female, anti-male, and anti-female statements was read by both male and female college students. After one reading of the passage the subjects were required to reproduce the material in writing at ten-minute intervals during the following hour. The results showed significant sex differences for recall of partisan items in the passage. The male subjects retained more pro-male, pro-female, and anti-female items than did the female subjects; women subjects retained more anti-male items. Although their recall scores were somewhat higher for pro-female items than for anti-female items, women excelled men only in retention of anti-male material. In general, these results support the principle that people tend to remember best whatever

▲ DIFFERENCES BETWEEN MEN AND WOMEN IN RECALL OF PARTISAN ITEMS



Based on Alper and Korchin, 1952

is favorable to their own attitudes. (Alper and Korchin, 1952).

The fact that women had better memory for anti-male items than for pro-female items requires further explanation. The general tone of the passage was derogatory to female students, and the authors of the study suggest that the women's emphasis on anti-male items tended to transform a generally anti-female passage into one more evenly weighted in terms of anti-male and anti-female connotations. It is also possible that the greater recall of anti-male items by the women functioned as a symbolic outlet for aggression. And since members of both sexes retained less of the material which was derogatory to their own sex, there is evidence that repression may have functioned as one of several factors inhibiting recall of unacceptable ideas. The results of this study indicate that the selective recall of emotionally packed material is determined by a complex of factors operating within the individual.

Social Factors

Factors in the social environment also influence how much is remembered.

In a study of the effects of group atmosphere on recall, subjects were divided into forty groups of four persons each. A story was read to each group; immediately afterwards the members were asked to write it down as they remembered it, without talking to any other member of the group. Then each group of four was asked to select a leader and to work together to recall the story as completely as possible. Finally, each member was asked to repeat his individual recollection.

Some of the groups were told that the experiment dealt with cooperative effort and were urged to cooperate with each other as much as possible. The remaining groups were told that a record would be kept of each individual's contributions to the group effort in order to determine which person had the best memory; this was intended to foster a competitive spirit. Half of the groups representing each condition were instructed to operate in a democratic manner and to make all decisions as a group, with the leader acting only as a coordinator. The other half were told to regard their leader as "the boss," with authoritarian powers to decide what should be included in the group report.

Group recall was superior to individual recall in all cases. Individual recall following the group discussion was superior to individual recall immediately after the reading. The superiority of group recall was more marked in the cooperative groups than in the competitive ones. This may have been due either to the cooperative atmosphere itself or to the fact that there was more participation in the cooperative groups (as was indicated

by questionnaires which the participants later filled out). No significant differences were found between the retention of the democratic groups and those with authoritarian leadership. When the ten groups showing the greatest average improvement between initial and final recall were compared to the ten groups showing least improvement, however, it was found that the superior groups were those in which members had liked working in the group and felt that the group had reached its own decisions (Yuker, 1955).

CHAPTER SUMMARY

A number of factors, some related to the learner's own ability and experience, some to characteristics of the subject matter, and some to the external situation, influence the course and quality of learning. Learning may be improved by *intent to learn* and by *reward* and *punishment*. Punishment is usually most effective when used in conjunction with reward. *Intrinsic motivation*, whether concerned with immediate objectives or long-term goals and interests, usually leads to better learning than *extrinsic motivation* such as grades.

The effect of *stress* on learning varies with individuals, acting as a strong motivating force for some but causing damaging mental blocks or anxiety reactions in others. *Frustration* results in stereotyped behavior and increases learning time.

Learning is greatly influenced by the characteristics of the material to be learned, especially its *amount* and *meaningfulness*. *Memory span*—the amount of verbal learning an individual can master in a single presentation—is higher for digits than for single words or letters, but meaningful poetry and prose can be learned more readily than can meaningless material.

Prior learning may have an important influence on later learning. *Positive transfer* (*proactive facilitation*) results when the prior task and the present task have similar stimulus-response combinations, whereas *negative transfer* (*proactive inhibition*) may result when stim-

uli used in the prior activity must be related to different responses, when conflicting associations must be learned, or when the items to be learned are not clearly differentiated from each other.

Psychological feedback (*knowledge of results*), is an important factor in facilitating learning, as is the proper *distribution of practice time*. Whether *massed* or *distributed* practice is better depends on the learning task and the stage of learning. Distributed practice avoids the lowered efficiency caused by fatigue or boredom and is superior for rote learning up to a certain level of complexity. Massed practice followed by distributed practice is best for learning ideas and principles; the reverse is true for motor learning. Massed practice is also best for logical reasoning problems, although an incorrect mental set is less likely to develop and persist with distributed practice. *Conceptualization* (mentally picturing the performance of a task) and *verbalization* are aids to motor learning.

Periodic recall is an aid to remembering what is read. *Whole* and *part* learning have their individual advantages, but a combination of the two probably achieves the best results in most cases. *Guidance* can greatly further learning by clarifying principles and establishing correct habits.

A special form of guidance in learning, which both teaches new material and gives the student a continuing opportunity to check his learning, is called *programed instruction*. Whether presented in a machine or via the printed page, programed material breaks the subject matter into small steps called *frames*, presented one at a time. A *linear* program goes in a single line from one frame to the next, usually calling for "constructed" (completion) responses. A *branching* program usually uses the multiple choice format, providing additional explanations for those who choose wrong alternatives. It is too early to say what the ultimate role of programed instruction in the schools will be. Thus far, it appears to be most helpful when it involves subject matter in which there is a logical progression of ideas, when it is used to provide a common background so that class time can be spent on more advanced work, and when

it is used in connection with a good text and an excellent teacher.

The effects of several special conditions on learning have been studied. Rapid learning can take place under *hypnosis*. In fact, some studies have demonstrated more efficient learning under hypnosis than in the waking state, but the important variables here have not been identified. No one has yet been able to give convincing proof that *subliminal* stimuli can be used to facilitate learning. Nor does learning occur during true *sleep*. Evidence has been found that learning and retention are adversely affected by *radiation*, especially when it occurs before the nervous system is mature.

A single all-round ability to learn and remember has not been found, but there may be ability *factors* common to different kinds of learning tasks. Fast learners appear to remember better than slow learners. *Learning set formation*, or learning how to learn, is an important factor in rate of learning.

In general, the quality of learning performance increases during childhood and up to maturity, but then declines in both speed and accuracy. Part of the age difference in learning ability is due to differences in motivation, decreased visual acuity with age, and interference from previously learned material. However, older people should not give up trying to learn.

There is much evidence that forgetting is not merely passive decay which occurs over a period of time. It is not inevitable and when it does occur it is a function of several factors,

many of which can be controlled by student or teacher. *Inadequacy of original learning* is often the major cause of forgetting. Going beyond adequate learning and *overlearning* the material is often an aid to retention. To maintain a high level of mastery, it is important to review as soon as possible after learning and again from time to time, emphasizing the most important and most difficult parts of the material. The activity that follows learning can either help remembering (*retroactive facilitation*) or hinder it (*retroactive inhibition*). Sleeping after learning results in the least forgetting; engaging in an activity closely similar to the original learning causes the most interference. Meaningfully organized material is not forgotten as readily as nonsense material.

Tasks interrupted before completion are more likely to be remembered than completed tasks—the *Zeigarnik effect*—except under stress, when the reverse is true. Memories which threaten the individual's self-esteem often meet unconscious resistance and are conveniently "forgotten"—a form of repression. In general, pleasant memories show a stronger tendency to persist than mildly unpleasant ones and both are better retained than neutral ones. A person tends to learn controversial material faster and remember it better when it agrees with his own attitudes. Factors in the social environment also influence how much is remembered. *Group recall* is superior to individual recall. Its superiority has been found to be greater in cooperative groups than in competitive ones.

Part Four Knowing the World

Chapter 8 Stimulation and Sensation

Chapter 9 Observation and Action

Chapter 10 Thinking and Deciding

Our next concern will be with the ways in which we come to know our world through our senses and through the complex processes of perception and thinking. First, we shall examine our sensory equipment. At every moment of life, awake or asleep, from sometime before birth until death, we are responding to the physical world around us and to conditions within the body through the cooperative action of several sets of sense organs. Psychologists do not yet know exactly how many different kinds of sense organs man possesses. There are certainly more than the traditional five—those of seeing, hearing, touching, tasting, and smelling. Other senses are involved in his knowing the position of his body in space, its movements, and its internal conditions and tensions when he is hungry, thirsty, or tired.

Our senses work differently and in various combinations according to the situation. Complex objects become known to us through the cooperative action of several senses. The enjoyment of a football game requires at least the joint action of vision and hearing. A good meal can be at its best only if enjoyed through a complex of sensory experiences including sight, taste, smell, touch, temperature, and perhaps even the mild pain of strong condiments.

Although certain occupations require efficiency of particular sense organs, no single sensory department is absolutely essential to life or even to enjoyment of life. The human being is remarkably adaptive. Blind people learn to read

with their fingers; color-blind people are often completely unaware of their deficiencies. Through lip-reading and special speech training, the deaf learn to communicate effectively.

Even when all our senses are functioning at maximum capacity, we do not always become aware of all the objects about us that are constantly giving off stimuli capable of arousing sensations of some kind. Nor do our senses directly identify these objects or tell us the relationships among them. Through the process of attention certain sensations are "screened out" and others made more prominent in consciousness. Through perception our sensory data are organized and given meaning in terms of our past experience and our present needs.

We shall also consider another important process—thinking, which sometimes involves perception but which may be carried on in an entirely abstract way, using symbols alone. We have all daydreamed, and we have all solved problems by simply visualizing the situation and possible solutions in our minds. Both these processes are examples of thinking which does not involve immediate perception. However, past perceptions are usually involved, as are the products of learning. And often personality traits and emotions affect both perception and thinking, causing distortion and inaccuracy. Thus none of man's mental processes can be studied or understood without reference to others. Man is an organism—a *whole*—not a collection of autonomous parts.

Chapter 8

Outline

GENERAL CHARACTERISTICS OF SENSATION

STIMULUS INTENSITY AND THE LIMEN
SENSORY ADAPTATION
RETENTION OF SENSORY EXPERIENCE

VISION—THE SENSE OF SIGHT

HOW OUR EYES WORK
VISUAL ACUITY
COLOR VISION
COLOR BLINDNESS

HEARING—THE SENSE OF SOUND

PHYSICAL AND PSYCHOLOGICAL BASES OF SOUND
THE HEARING MECHANISM
DEAFNESS

THE SOMATIC SENSES

PRESSURE
PAIN
COLD AND WARMTH
THE KINESTHETIC SENSE
THE LABYRINTHINE SENSE
SOMESTHESIS AND THE BRAIN

THE CHEMICAL SENSES

THE OLFACTORY SENSE
THE GUSTATORY SENSE

Chapter 8 Stim

All knowledge comes to us through our senses.

We are so busy, however, using our intricate and efficient sense organs that we seldom pause to think about how they operate, how very sensitive they are, or even how much our daily adjustments depend upon them. Nor do we ordinarily make full use of our senses. Our eyes, for example, can detect a match flame twenty miles away under ideal atmospheric conditions. Or they can perceive a fine wire whose diameter is equal to 1/500,000 of the total field of vision. Theoretically this is equivalent to seeing a telephone pole (one and a half feet in diameter) at a distance of forty-five miles! Astronaut Gordon Cooper amazed the public when he reported that he had recognized a moving train from a height of more than a hundred miles—a much easier visual task. What complex mechanism makes such keenness of sight possible? And what delicately tuned apparatus enables us to hear the low rumble that gives a sensation almost like that of touch or the high screech that is almost like pain?

As we saw in Chapter 2, four essential steps are involved if stimulation is to lead to sensation:

1. A *stimulus* must be supplied, internally or externally. A stimulus, as you will recall, is some form of radiant, mechanical, or other energy that activates a receptor, or more often, a large group of them.

ulation and Sensation

2. The stimulus must stir certain *receptor cells* or nerve endings into activity. Usually a receptor cell is activated only by a particular form of energy—a visual receptor by light waves, a taste receptor by chemical substances, and so forth. While a receptor may occasionally be stimulated by other kinds of energy, even then it responds in its own characteristic manner. If you apply pressure to your eyeball, for example, you will “see stars”—a visual sensation.

3. Nerve impulses must travel from the receptor cells or nerve endings through the central nervous system to the brain.

4. Activity must be aroused in the sensory areas of the brain, producing conscious sensations. Each class of sensory activity has its own special center in the brain, as we shall see.

If any one of these four steps is missing, there is no sensation, and steps 3 and 4 do not follow automatically from steps 1 and 2. Much incoming nervous activity is “lost” or inhibited within the central nervous system even following adequate stimulation. The factors that determine which incoming messages we select and attend to are discussed in the next chapter.

Stimulus Intensity and the Limen

Energy strong enough to produce a response is said to be above the *absolute limen* (threshold); energy too weak to produce a response is *subliminal* (below the threshold). Sensory sensitivity is also measured by the *difference limen*—that is, the smallest difference in stimulus intensity that a particular sense can detect. But this is not a simple, unchanging amount. For example, if a single 40-watt lamp is burning in a room and someone turns on another of the same wattage, we immediately notice a consid-

erable difference in total illumination. If someone turns on a 40-watt lamp in a brightly lighted ballroom, however, we will not perceive any change in total illumination.

Whether our senses can discriminate a change in stimulus intensity depends upon the ratio of the added intensity to the intensity of the previous stimulation. For example, if 2 grams had to be added to a 100-gram weight before a subject felt it as heavier, 4 grams would have to be added to a 200-gram weight before he would notice any difference. The exact ratio varies with the kind of sensitivity being measured and with the range of intensities involved, but, in general, the smallest perceived difference in stimulus intensity is a constant proportional part of the comparison stimulus. This is known as *Weber's law*.

Although a sensation becomes stronger as the stimulus becomes stronger, this is not because the receptor cells produce larger nerve impulses. Different receptor cells have different thresholds and with stronger stimulation *more cells* are caused to respond and each cell responds *more frequently*. Following stimulation, as we saw in Chapter 2, a given neuron will

either react with full intensity or it will not react at all.

Sensory Adaptation

Another important characteristic of sensory action is the phenomenon of *adaptation*—the adjustment of the senses to a particular stimulus. After being in a darkened room for a short time, we gradually begin to see more clearly. We usually are unaware of the pressure exerted by clothing or a wrist watch. These are a few examples of sensory adaptation; later in this chapter we shall have occasion to discuss many others. All of our senses adapt, though some adapt more completely than others.

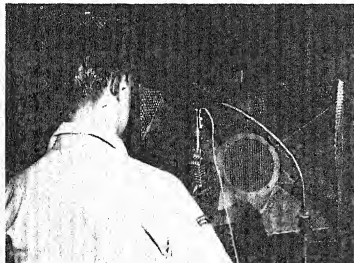
Retention of Sensory Experience

Sensory experience is remarkably stable over time. In a series of experiments recently published, subjects were given a variety of sensory experiences and were later tested for ability to recognize the experience after delays of various lengths.

Various types of stimuli were used: visual intensity (brightness); auditory intensity (loudness); visual frequency (flash rate); auditory frequency (pitch); visual duration (flash length); and auditory duration (tone length). Short delays were of fifteen, thirty, or sixty seconds; longer delays ranged from one to twenty-eight days.

In each stimulus situation the subject was asked to adjust the stimulus-controlling apparatus to produce the same experience as he had had before the delay. For example, in the visual intensity test the subject, after ten minutes of adaptation to the low illumination of the darkroom in which he was seated, was asked to look at a round test patch on a panel before him. He was told that after a "ready" signal this patch would be lighted for five seconds and he must notice how bright it was. After the interval of delay he was asked to adjust a manual control that continuously varied the intensity of lighting on the test patch so that the patch would be of the same brightness as during the original illumination.

In general, the matches made by subjects showed unusual accuracy and stability, coming very close to the original stimuli, even after relatively long periods of delay. Certain trends, such as that toward a gradual in-



◆ Thresholds for detecting sounds in a quiet room may be quite different from those for hearing and understanding speech signals in the presence of various kinds of noise. The U.S. Air Force is making extensive tests of men's hearing ability under many conditions; in this picture a subject in a special anechoic chamber is trying to detect test words through a special hearing aid.

crease in estimated auditory intensity after delay, were consistent after both short and long delay (King, 1965).

Just why this type of experience is so stable whereas equally meaningless combinations of letters or digits are so quickly forgotten (Chap-

ter 6) is a mystery to be solved only by further research.

So far we have been discussing general conditions of all sensory activity. In the remainder of the chapter we shall investigate each of the chief senses in turn.

VISION—THE SENSE OF SIGHT

The sense of sight, so important to survival, has followed a fascinating course of development. The intricate human eye apparently has evolved from a few light-sensitive cells such as those found in primitive forms of life. Gradually, as more advanced forms developed, there appeared a greater and greater number of visual elements per unit area, an especially sensitive central spot, and more complex nerve pathways and brain areas which made possible a more accurate appreciation of visual patterns (Detwiler, 1956). The eye has also developed to make use of any light which is available at night, giving it enormous range. In monkeys and man, the eyes also moved gradually around to the front of the head so that binocular vision became possible. As we shall see in the next chapter, man's ability to see his physical environment from two slightly different points is of great importance.

In the course of evolution, some species acquired very queer-looking eyes indeed. But despite differences in appearance, the eyes of all vertebrates have much in common with the human eye and operate through similar mechanisms. All have three layers: (1) an outer protective coat called the *sclera*, a portion of which is the transparent *cornea* whose air interface acts as a refractory surface; (2) a middle layer called the *choroid coat* which is pigmented; and (3) a light-sensitive inner layer called the *retina*. Oddly enough, the light must travel through nerve layers and blood vessels in the retina before reaching the receptor cells. These layers distort the entering light rays. Much of the light

also passes on through the retina without stimulating any receptor. The mechanism of the eye is shown in the diagram on page 260.

Although man's superior brain connections enable him to make more intelligent use of his eyes, the human eye is inferior to that of reptiles and birds in some respects. The visual acuity of some hawks and eagles, for example, has been found to be eight times that of the human eye. Nevertheless, our eyes are wonderful possessions and few if any of us would want to do without them.

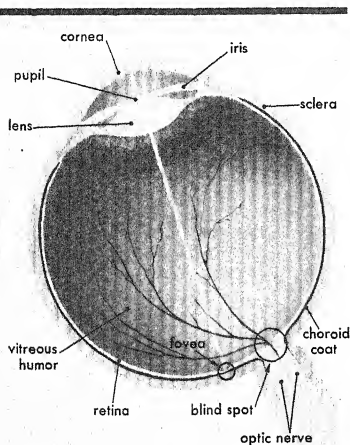
How Our Eyes Work

In studying human vision, the psychologist is interested primarily in *visual acuity* (sharpness of vision) and *color discrimination*. Both underlie the perception of forms and the recognition of objects, to be discussed in the next chapter.

Anatomy of the eye. Camera fans will be quick to see certain resemblances between the eye and the camera. Both have an adjustable opening to regulate the amount of light coming in and other devices for focusing. Both have a sensitive surface to receive the image. Although the eye does have a lens, it is for small adjustments in focusing, the main job of bending light being done by the cornea. The eye, however, is far more sensitive to light than is photographic film. In fact, physiologists have calculated that the human eye has reached the

CROSS SECTION OF THE LEFT EYE SEEN FROM ABOVE

In order for us to "see" something in the outer world, a pattern of light from the object must pass first through the cornea (a protective covering transparent in front) and then through the pupil. The pupil is an opening in the iris, which adjusts in size to regulate the amount of light entering the eye. This influences the brightness and the clarity of the image. The light rays penetrate the lens, which focuses them onto the sensitive surface of the retina. This sets up chemical reactions in the retinal receptors, initiating nerve impulses which travel through the optic nerve and ultimately reach the occipital lobes at the back of both hemispheres of the brain.



ultimate in sensitivity to light. Under certain conditions, it responds to one *quantum* of light energy—the smallest possible amount.

Every point in the visual field simultaneously reflects light to visual receptors in the retina, creating a pattern of stimulation that is carried by nerve fibers to the brain. Where the nerves leave the retina there is a blind spot; ordinarily we are unaware of it because when we are using both eyes an image never falls on both blind

spots at once, since each faces a different part of the visual field.

Seeing by day and by night. The eye is made up of two visual systems combined into one, each specialized for a different function. Each system has its own distinctively shaped receptor cells; those of one system being called *cones* and those of the other *rods*. The cones and the pathways leading from them function only in the light; they are responsible for color vision and high visual acuity. In darkness the cones are no longer stimulated and the second system, that of the rods, functions alone. Through the process of dark adaptation described below, the rods become extraordinarily sensitive, responsive to the smallest imaginable quantity of light. This night vision system does not respond to the color of objects, however, but gives only white, grays, and black. Nor does it record the fine detail and sharp contours seen in the daytime; thus objects may be difficult to recognize at night.

There are more than 7,000,000 cones in the human retina. They are packed most closely together in the very center of the retina, an area known as the *fovea*. There are no rods in the fovea, and neither rods nor cones are found at the blind spot.

Dark adaptation. All eyes—including a cat's—are alike in that none of them can see in complete darkness. But the human eye can adjust remarkably well to changes in the intensity of illumination. A piece of white paper with printing on it held in direct sunlight can still be read, although such strong reading light is uncomfortable for all eyes and even injurious to some. At the other end of the scale, people are capable of seeing under illumination only one seven-billionth as strong as ordinary daylight, provided the eyes are properly prepared. You undoubtedly have had the experience of going into a darkened theater and being unable to find your way to an empty seat without help. Yet after a few minutes, you were able to see quite well. The process which prepares the eyes to see under low illumination is known as *dark adaptation*. For most people, complete dark adaptation requires about half an hour of darkness after the last use of the eyes in bright light.

Discrimination between hues becomes less keen as the level of illumination falls, finally disappearing completely as the "color-blind" rods take over the job of seeing. This change-over from the cones to the rods occurs when the level of illumination falls to about the degree of illumination provided by a full moon. • Dark adaptation is assisted by a widening of the pupil, permitting more light from each external point to reach the retina.

As the eye becomes adapted to darkness, sensitivity is lost first to red and yellow, then to blue and green. This is known as the *Purkinje effect*; it explains why the hues at the violet or short-wave end of the spectrum seem to become bright at nightfall, whereas in the daylight they seem darker. Early in World War II air-raid wardens used blue flashlights—an extremely ill-advised practice, because under blackout conditions blue is seen better than any

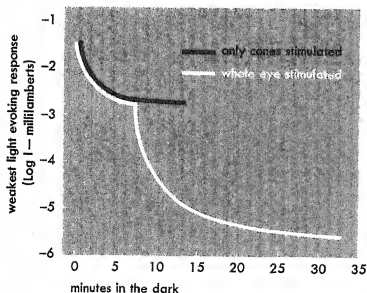
other hue by the dark-adapted eyes of observers. A similar error was made in providing blue lighting on naval ships, but was quickly corrected by the substitution of red lighting. The rods are nearly blind to the red part of the spectrum.

Another advantage of red light is that it permits the cones to see while the rods are becoming dark-adapted. This fact is utilized in situations where military or professional personnel must shift from bright to blacked-out areas of work without having time to let their eyes become adapted. For example, it is recommended that before going on night lookout duty a sailor either wear red goggles or stay in compartments illuminated by red light. Complete dark adaptation cannot be achieved even under these conditions, however, since the rods are not *totally* insensitive to red light.

You can perform a simple but interesting experiment on dark adaptation by staying in a dark room for half an hour. At the end of this period close one eye and, holding your hand over it, turn on the light for a few seconds. Then turn off the light again. Observe the room first through the eye that has been closed all the time and you will be able to see objects fairly clearly. Then close that eye and observe the room through the eye that was exposed to the brief period of light; the room will appear totally black. This simple experiment demonstrates that the process of dark adaptation takes place in the retina of each eye rather than in the brain. In training soldiers for night missions, the Army teaches them to keep their sighting eye closed when setting off a flare or otherwise using light. This eye thus retains its dark-adapted condition, making accurate marksmanship possible.

"Light adaptation" is also a familiar phenomenon. We have all experienced the painful glare of light when, for example, coming from a movie theater into the sunshine outside. This is because the rods, which have become extremely sensitive in the dark, are overstimulated. After a few minutes, however, they lose this sensitivity and the cones take over. Light adaptation is acquired more quickly than it is lost; dark adaptation is lost more rapidly than it is acquired.

Eye movements in focusing. Various muscles inside and outside the eyeball are working con-

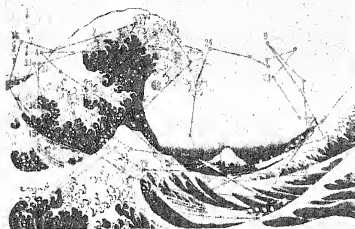


Based on Hecht, 1934

THE CURVE OF DARK ADAPTATION

At first there is a rapid drop in threshold, followed by a plateau. After about seven minutes, the rods begin to respond and again there is a rapid drop, after which the curve levels out again. That the upper part of the curve is due only to cone action, despite the fact that both rods and cones are being stimulated, is shown by the fact that when red light is used to stimulate only the fovea (ensuring that no rods could be receiving stimulation), the black curve in the diagram is obtained.

▲ The eye movements a subject makes while looking at a picture or reading an article can be recorded by a camera developed by the late Dr. Herman F. Brandt. The movements are then plotted on transparent paper which is laid over the picture or article, showing at a glance the course traversed by the subject's eyes and the order of his fixations. The shifts in fixation in viewing paintings have been carefully studied by G. T. Buswell; a typical record of how the eyes behave is shown below (Buswell, 1935). Each dot represents a fixation; the numbers are provided to aid the viewer in following the order.



stantly to focus objects accurately on the retina and to bring the light waves coming from what you want to see onto the fovea. Some movements are consciously induced. Others are involuntary. Some move the eyeball, others change the shape of the lens.

1. *Convergence.* When focusing on objects within about twenty feet, the eyes turn toward each other so that both eyes may fixate the same point in space.

2. *Accommodation.* The lens thickens to focus on near objects and flattens for distance vision.

3. *The pupillary reflex.* The muscles of the iris adjust the size of the pupil, regulating the amount of light entering the eye. A contracted pupil, like the shutter on a camera, produces a sharper retinal image and increases the depth of focus. The pupil also contracts automatically in response to an excessive amount of light, preventing damage to the retina.

4. *Cyclofusional movement.* An independent rotation of each eye about its axis adjusts

light from an object so that it strikes corresponding parts on the two retinas. This delicate adjustment sharpens the retinal image.

5. *Conjugate movements.* To change the fixation from one equidistant point to another the two eyeballs shift together like two searchlights side by side "looking" at the same object. This ensures that the light from the focused points continues to fall on corresponding points of the retina.

Conjugate movements are of two kinds: *jump* and *pursuit* movements. Photographic records of eye movements show that in moving to examine parts of a motionless field the eyes do not glide smoothly but make a series of jumps—they jump, then stop, then jump again, bringing successive parts of the material into sharp focus. ▲ Thus the eyes stop several times in reading a printed line. Only during the pauses are things seen clearly. During the rapid movement, objects would be blurred, but we learn to ignore these brief blurs.

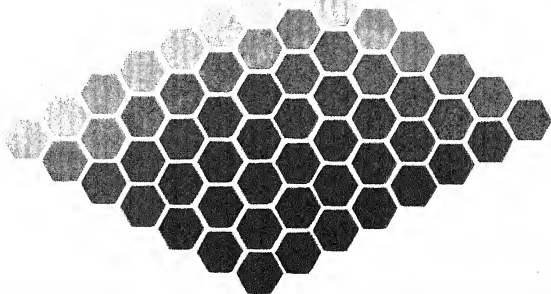
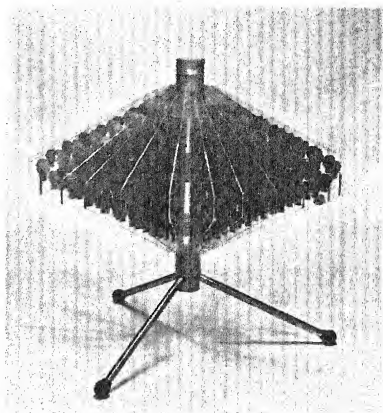
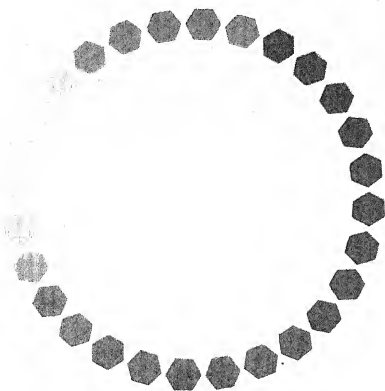
To see a moving object clearly, the eyes glide in pursuit movements. The motion of the eyes must correspond with that of the object if the image is to keep falling on or near the fovea; that is why they are said to be in "pursuit" of the object.

The eyes move more easily in the horizontal plane than in the vertical. This is fortunate, since we more often keep clearly in sight objects coming from the side than those from above or below.

An interesting indication of the greater ease of side-to-side as compared with up-and-down eye movements is seen in the results of tests on young babies. One psychologist determined the average age at which external objects first aroused pursuit movements of the eyes. Side-to-side movements appeared at fifty-eight days, up-and-down movements at sixty-five days, and round-and-round at seventy-eight days (Jones, 1927).

The stabilized image. It is impossible to keep our eyes from moving, no matter how hard we may try to stare fixedly at an object. This is as we would wish it to be, because a person with fixation entirely stable would be nearly blind! A psychologist has designed a simple apparatus by which, despite the eye's constant movements, a

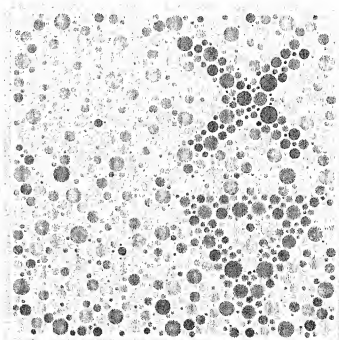
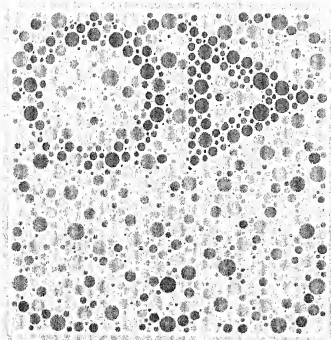
The relationships between hue, brightness, and saturation can be seen in the three-dimensional color solid and the horizontal and vertical sections pictured below. The circular horizontal section is what we would see if we cut through the color solid at its widest point and kept only the hues of highest saturation—those around the outer edge. The diamond-shaped section, cut vertically through the middle, shows the diminishing saturation from the outer edge toward the center pole and the increasing brightness from the bottom toward the top. A completely accurate model, of course, would show continuous gradations of hue, saturation, and brightness, with adjacent colors blending into each other. This model is built according to the Ostwald color system.



Shown here are reproductions of color plates from two of the currently used tests of color blindness. At the left are two examples of the Dvorine Pseudo-Isochromatic Plates, developed on the principle that color-blind people distinguish between certain colors only on the basis of brightness. The test can detect either red-green or total color blindness. The upper plate is easily seen as "48" by both normal and red-green blind persons, but the lower one, which normal people see as "32," is difficult or impossible for individuals with red-green deficiency to read. Alternate plates for illiterates and young children have winding trails which the subject outlines with his finger.

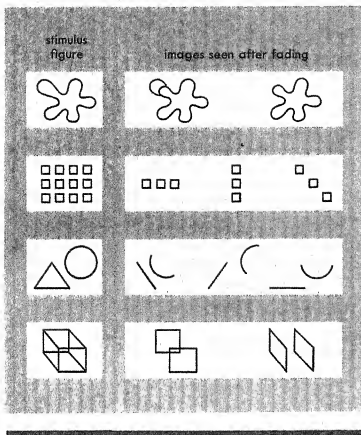
Below are two examples of the Hardy-Rand-Rittler Pseudo-Isochromatic Plates, which use colored triangles, circles, and squares instead of digits. This test detects deficiency with respect to red, green, yellow, blue, or a combination of these hues, and by using hues of graded saturation it also indicates whether the defect is mild, moderate, or severe. Thus if an individual fails to see either or both of the figures in the plate on the left, it means that he has a green or red-green deficiency of moderate severity. Such an individual would probably have no trouble with the plate on the right, which detects a moderate yellow-blue deficiency—a much rarer condition. In both the Dvorine and the Hardy-Rand-Rittler tests the hundreds of dots on each plate are arranged in exactly the same pattern, making it impossible for anyone to "beat the test" by memorizing patterns of dots.

These reproductions are only for teaching purposes and are not suitable for actual testing. The plates used in testing are larger, are printed with specified inks, and must be viewed under specified illumination.



light at any point in space may be made to fall steadily on the same rods and cones.

In these experiments the subject wore a special contact lens with a tiny mirror attached to it. An image of the test object was projected to this mirror, which reflected it to a screen in front of the eye. The subject viewed the image on the screen through a system of prisms. The effect of this apparatus was to make the image of the test object always fall upon the same receptor cells, thus "cancelling out" the involuntary movements of the eye.



STABILIZED IMAGES

When figures instead of lines were shown and all eye movements were cancelled out, the fading that occurred was not random but followed predictable laws. For example, if an irregular shape was projected, the most irregular part faded first and a less irregular part appeared in its place. A pattern composed of rows of squares faded in such a way as to leave one row visible—horizontal, vertical, or diagonal. If a circle and triangle were fixated, one or the other might disappear leaving the other intact, or parts of both might disappear; in the latter case, the parts left were parts that were roughly parallel to each other. Parts of a cube usually faded so that parallel planes were left.

Wires of various diameters, appearing as black lines, were presented one at a time.

It was discovered that when the lines were projected for very short intervals, subjects could see finer lines when their eye movements were artificially "canceled out" by the apparatus than under normal viewing conditions. However, when subjects viewed each line for a full minute through the apparatus, the lines soon faded. The heavier ones tended to reappear from time to time during the minute interval, but the fine lines were "lost" permanently. When the same slides were projected under normal viewing conditions, the heavier lines did not fade at all; the fine lines faded but reappeared. When the apparatus was used again but adjusted differently so as to double the normal extent of eye movements, not even the fine lines faded; in fact, the lines seemed to be "locked in place" on the screen (Riggs, Ratliff, Cornsweet, and Cornsweet, 1953; Pritchard, 1961). ■

"These experiments show that eye movements help maintain sharp vision by shifting the visual image from one group of receptor cells to another so that it does not fade out.

Visual Acuity

Visual acuity means literally "sharpness of vision." It is determined by two factors: the efficiency of the eyeball mechanism and an intricate system of neural structures.

The neural basis of visual acuity. The role of the nervous system in determining visual acuity begins with the patterning of receptor cells in the retina. The complex neural pathways through the brain involving inhibition and facilitation of impulses also play a major role.

Receptor density. Visual acuity is greatest in the fovea, where the cones are packed most tightly together. It is best, too, under good light, which is capable of stimulating the least sensitive cones as well as the most sensitive ones. The brain can draw a straighter line or a better picture if it is allowed more "dots."

The size and shape of an object in the external world determine the size and shape of the pattern of receptors stimulated on the retina. It was once thought that to "see" a line, at least two separate receptors must be stimulated. If this were true, we would expect that the image

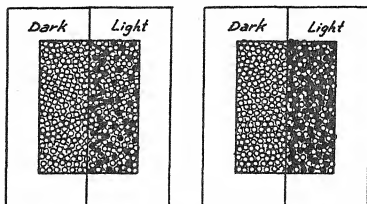
of an object would have to be about .0001 inch long in order to be visible, since receptors are about that far apart. However, in certain circumstances the normal eye can see objects that produce images only one-eighth as great as .0001 inch in one dimension, provided they are great enough in the other dimension. Why this is will be explained shortly.

The eye cannot distinguish two lines as separate unless the retinal areas stimulated by light from the lines are separated by one functional unit which is not stimulated. A functional unit consists of all the retinal cells which are linked to one connecting nerve fiber or channel; the size of such units varies in different parts of the retina. In the fovea separate nerve connections may exist between each foveal cone and the central nervous system. But toward the outer edge, or *periphery*, of the retina, more and more of the retinal cells are linked together on a "party line." Therefore, in order for two lines in the visual field to be distinguished as separate when their images fall on the peripheral zones of the retina, they must be separated by a much greater distance—roughly equal to the width of the average group of cells. This is the main reason why we cannot see fine detail out of the side of our eyes.

Actually, we now know that the concept of stimulated-unstimulated-stimulated cones or cone groups as establishing the limit of visual acuity is an oversimplification. Due to the normal errors of the lens system, the constant small eye movements, and certain neural factors, a point in space is translated not into a simple point of light on the retina but into an area of stimulation, with maximum excitation at its center and decreasing excitation toward its edge. Thus much of the discrimination made by the sensory system is not between stimulation and nonstimulation but between the points maximally stimulated and the surrounding, less stimulated areas.

Perhaps you have wondered just why it is harder to read fine print in a poor light. Recognizing letters consists basically of seeing the border between light and dark patches. Every receptor can be thought of as a point which can be used in establishing such a border. Each of the diagrams below represents a visual field with the left-hand side shielded by the shadow

of an object. Filled circles represent active units and unfilled circles inactive ones (Ruch, 1965).



Under dim illumination (*left*) only a few low-threshold cones are active, and a line drawn from one to the next would be a coarse zigzag; thus the individual sees a blurred edge. In a bright light (*right*), with more cones stimulated, a very sharp border can be distinguished. Another factor is also at work. In bright light the pupil of the eye becomes smaller. This increases the sharpness of focus in much the same manner as a pinhole camera.

Central mechanisms in vision. Visual sensory experience has a complex neural basis that starts with the light-sensitive rods and cones of the retina and continues along neural pathways through the central nervous system to the cortex in the occipital lobe of the brain (see diagram, p. 55). The central mechanisms of sensation come into operation at the first synapse which the message encounters on its way upwards. This is located at the base of the receptor itself. One of the important functions of this system is to adjust the sensitivity or power of the visual mechanism to the demands of the visual task. Obviously situations may be encountered in which full sensitivity is required—as in twilight vision. But the eye must also function in bright sunlight. The numerous relay stations in the central nervous system and brain serve to step up weak stimulation and step down strong stimulation. Thus we see that central mechanisms as well as retinal ones help us adapt to different intensities of illumination.

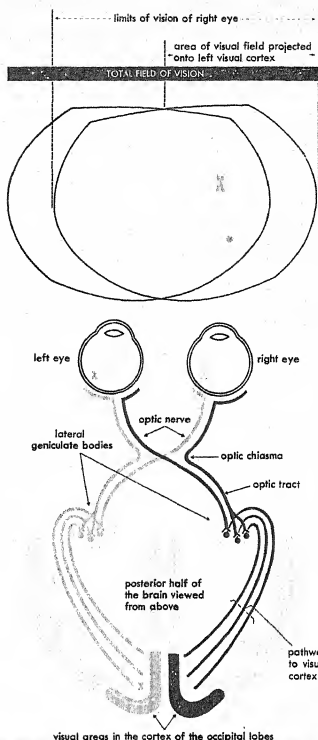
The huge bundle of nerve fibers constituting the optic nerve leads back from each retina, forming a partial cross at a point called the *optic chiasma* located at the base of the brain, well back from the eyes. The fibers from the inner

or nasal half of each retina cross and go to the cortex of the occipital lobe in the opposite hemisphere, while the fibers from the outer or temple side of each retina go to the hemisphere on the same side. Thus one point in the external world is "seen" by one point in the brain. The *left* halves of both retinas, which receive light rays coming from the *right* side of the visual field (because the image on the retina is reversed by the lens), send fibers to the left hemisphere of the brain as we saw in Chapter 2. In vision as well as in touch and motor control, the *right* side of the body or of the external environment is managed by the *left* side of the brain.

If the optic nerve from one eye is damaged between the retina and the optic chiasma, a person loses vision in the corresponding eye, but if the occipital cortex on one side is damaged, the person loses vision of one half of his visual field (the half on the opposite side). In this latter case, because only half of each retina is blind, the condition is called *hemianopia*, or "half-inability-to-see." Destruction of the visual area of both sides of the brain results in complete blindness in man. In monkeys and chimpanzees, however, destruction leads to loss of color vision and pattern discrimination, but ability to discriminate between darkness and light still remains.

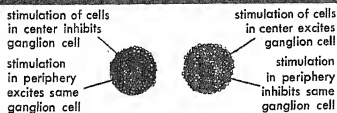
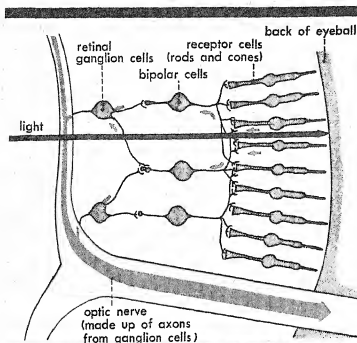
When light falls on a particular point of the retina of a normal eye, electrical activity can be detected at a corresponding point on the occipital cortex. By moving a point of light and noting the change in position of maximal electrical activity, the occipital cortex has been mapped, and a fairly close point-to-point correspondence between the visual area and the retina has been established. This suggests that the retinal "picture" of the outside world is translated into a corresponding pattern of nerve activity on the cerebral cortex.

Neurophysiologists have been greatly aided in their studies of visual pathways by the development of a device so sensitive that it can measure the electrical discharge from a single neuron. With this device they can study neurons at each stage of the visual pathway between retina and cortex and identify the exact retinal areas from which impulses can travel to a given neuron in the chain; this is the *receptive*

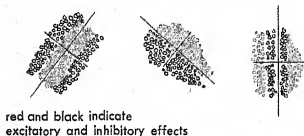


THE MECHANICS OF SEEING

In normal vision, light from one point in the right half of the visual field stimulates points on the left halves of both retinas, instigates neural activity over two nerve pathways, and finally activates only one point in the left visual cortex, as shown above. Light from an adjacent point in the visual field will, in turn, activate a different but adjacent point in the visual cortex. Thus a single image of the world is built up despite the double pathways to the cortex. Meanwhile, the points in the left half of the visual world are activating points in the right half of the visual cortex.



RECEPTIVE FIELDS OF TWO GANGLION CELLS

RECEPTIVE FIELDS OF THREE SIMPLE CORTICAL CELLS
(small circles in both diagrams represent retinal receptors)

Hubel, 1963

VISUAL PATHWAYS AND RECEPTIVE FIELDS

Nerve impulses from the receptor cells travel through bipolar cells and retinal ganglion cells to reach the optic nerve, as shown in the top diagram. (Note that the light has actually passed through these cells on its way to the receptors.) Both convergence and divergence can occur, as indicated by the overlapping connections of the various neurons; thus neurons at different levels of a particular sequential chain can have receptive fields in the retina that differ in both shape and size. The bottom part of the diagram shows the characteristic shapes of ganglion cells and simple cortical cells. In both cases adjacent inhibitory and excitatory parts of the receptive fields can be identified.

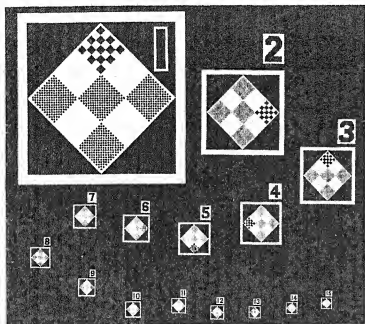
field of the neuron concerned (Hubel and Wiesel, 1962). Surprisingly, they have found that successive neurons in the same chain are affected by stimulation of somewhat different groups of retinal cells and that when a particular retinal cell is stimulated, it may either excite or inhibit a given neuron.

The first neurons in the visual pathway are *bipolar cells* which conduct messages from the rods and cones to *ganglion cells*. Both convergence and divergence occur in this conduction: several retinal cells may send impulses to the same ganglion cell, and a given retinal cell may send impulses to more than one ganglion cell. When the receptive field of a particular ganglion cell is mapped by finding which cells in the retina affect its electrical activity, it is invariably found that the field is circular, with the center and the surrounding area having opposite effects: if stimulation in the center of the field excites the ganglion cell, stimulation in the surrounding area will be found to inhibit it, whereas if stimulation in the center is inhibitory, then stimulation in the surrounding area will be excitatory.

The same pattern of adjacent receptors with opposed action is found when the receptive retinal fields of cortical cells in the occipital area are mapped, but with an important difference. Here the fields are not circular but lengthwise and may lie in any orientation on the retina. But whatever their orientation, there will be excitatory or inhibitory parts. In this case there may be three parallel sections, with the two outside parts opposite to the central one or two parallel sections—one excitatory and the other inhibitory. Whereas ganglion cells are most responsive to *spots* of stimulation, simple cortical cells are most responsive to stimulation by *lines* that correspond to their direction of orientation. Complex cortical cells, which receive stimulation from many simple cortical cells, respond to lines projected on their retinal field in any orientation.

Measuring visual acuity. *Visual acuity* may be defined in terms of (1) the smallest object that can be seen at a standard distance or (2) the minimum distance which must separate two lines for them not to fuse into one line. You have undoubtedly heard it said of some keen-

◆ Shown here (left) is a sample of the slides used in measuring visual acuity with the Ortho-Rater. The boy (right) is being tested with the School Vision Tester, which uses "Tumbling E" slides instead of checkerboard ones. The subject must tell the examiner whether the prongs of the E go up, down, to the right, or to the left. This apparatus is used by schools for quick identification of children whose eyes need further attention.



sighted individual, "He has perfect vision—20/20 in both eyes." Such a person might be described more accurately as having "standard" vision, because the number 20/20 simply indicates that he is able to see a standard-sized object from a standard number of feet away. This method of measuring visual acuity developed from the use of the Snellen chart of test letters, placed twenty feet from the subject being tested because at twenty feet the light rays from a given point are virtually parallel. Eyes are described as "20/20" if at twenty feet they can distinguish those letters of the sign that the average person can distinguish at twenty feet. A rating of 20/10 vision means that the person can still see at twenty feet a letter which the average person could see only at a distance of ten feet. Conversely, 20/40 vision means that at twenty feet a person requires letters of a size which the average person could see at forty feet.

Although widely used, the block-letter charts are unsatisfactory in some respects. For one thing, if a person wants to cheat, he may be able to memorize the letters ahead of time. A more serious deficiency is that the letters of the

alphabet lend themselves to guessing and differ in legibility. And, of course, the chart is useless for an illiterate person.

The armed forces have conducted extensive research on the measurement of visual acuity and have obtained good results with two visual screening devices, the Ortho-Rater and the Sight Screener (Sulzman, Cook, and Bartlett, 1946). The Sight Screener, for individual testing, measures depth perception, muscle balance, and simultaneous binocular vision as well as visual acuity. A color discrimination test for use with this instrument is also available. When the Ortho-Rater is used, the subject views a series of slides on which he is asked to identify the location of a black and white "checkerboard," which may be in any one of four positions. Smaller and smaller slides are presented until two successive ones are missed. Tests of this kind are convenient for use with groups when individual tests are not feasible. ◆

It is possible to test the visual acuity of infants by making use of the fact that in darkness a baby will look toward a light, provided it is not glaring (Schwartz, 1954). The apparatus used is a box decorated with gay clown designs

and containing a light bulb. In the front of the box is a frosted glass window across which steel wires of various diameters are moved. Regular movement is assured by fastening the wire to the arm of a metronome. The smallest wire which the eyes follow provides the index to the child's visual acuity. This device is perfected to the point that for adults it is predictive of performance on the widely used Snellen block-

letter charts. As determined by this device, normal vision is 20/400 at six months, 20/200 at one year, and about 20/50 at three years.

Common visual defects. Although vision will be impaired by defective functioning of *any* of the components of the eye, a faulty optical mechanism is responsible for most of the common difficulties in seeing.



These photographs show the visual distortion caused by some common physical defects. In myopia (upper left) and hyperopia (upper right) only a portion of the visual field is in correct focus. In astigmatism (lower left) vision is blurred in one dimension, and in diplopia (lower right) the images transmitted to the brain by the two eyes do not correspond.

The lens and cornea may be too strong for the length of the eyeball, causing the light rays to come into focus slightly in front of the surface of the retina, and spread out again so that the image is fuzzy. An individual with this condition suffers from *myopia*, or near-sightedness. He sees light rays diverging from close objects but the parallel light rays from distant objects are out of focus. Thus he must hold paper work close to his eyes to see it clearly.

On the other hand, the refracting mechanism may be too weak. In such cases the image comes into focus behind the retina. This condition is known as far-sightedness, or *hyperopia*. Although distant objects may be seen distinctly, nearby objects are blurred.

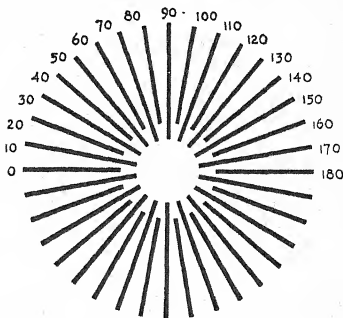
A "far-sighted" person cannot see any farther or any better than a normal person. In fact, he cannot see as well. By using all of his lens power he can just manage to bring the nearly parallel light rays from a distant object to a focus, but he cannot bring light rays from near objects to a focus; thus he cannot see them as clearly as can the person of normal vision.

Fortunately, both of these visual defects can be corrected readily by glasses. So can old-sightedness, or *presbyopia*, a special condition of far-sightedness brought on by a hardening of the lens which occurs with age. Even near-sighted people may develop this condition. As an individual gets older, the lenses lose their elasticity, becoming flatter and hence weaker. Therefore they cannot bend the light rays diverging from near objects enough to bring them to a focus on the retina. The nearest point at which the eyes can be focused becomes farther and farther away, as shown in the table below (Boring, 1945). Notice the rapid change beginning around the fortieth year.

Age of reader	Distance of blur point from eyes
10	3 inches
20	4
30	5.5
40	8.5
50	15.25
60	39 or more

To determine your own blur point, hold this book out in front of your eyes and move it closer and closer until you have reached the point

This figure is used as a test for astigmatism. To an individual with astigmatism, the lines appear to differ in clearness, the grayest and blackest lines indicating the axes of greatest and least curvature.



where the printing becomes so blurred as to be illegible. Have a friend measure the distance between the book and your eyes and check his reading against the table to see how you compare with others of your age. The table, of course, is based on averages of people who are neither far-sighted nor near-sighted; individual deviations can be expected.

Another common visual defect, *astigmatism*, may be caused by the left-right curve of the cornea and/or lens being sharper (or flatter) than the up-down curve, making vision clear in one dimension but unfocused in the other.

Double vision, or *diplopia*, is caused by a muscular imbalance which permits light reflected from one point to fall on noncorresponding receptors in the two retinas, so that two different images are transmitted to the brain. This defect can be caused not only by an inherent weakness of the involved muscles but also by disease, by various poisons, or temporarily by alcohol (Brecher, Hartman, and Leonard, 1955). In cases of diplopia, one image may be involuntarily suppressed. If this goes on indefinitely, vision is lost in the eye whose image is suppressed.

Certain conditions, such as excessive use of tobacco or alcohol and overexposure to light, produce a temporary or permanent blind spot, *scotoma*, which seriously interferes with vision. Scotoma also accompanies some diseases, including migraine. It may develop when the retina is injured or diseased, or it may originate in the optic pathways in the brain.

Color Vision

Most people can distinguish between many more colors than they can name (Chapanis, 1956). Indeed, it has been estimated that a person of average vision can distinguish 7,295,000 separate surface colors! These distinctions, of course, include other dimensions of color besides hue (Nickerson and Newhall, 1943).

The qualities of color. Suppose you were asked to describe the clothes worn by a couple whom you had seen at a party the night before. You might say, "Dick was wearing a dull, grayish-blue suit and a red tie, and Barbara was wearing a striped dress of varying shades of red." Even in this simple description of colors, you would be referring to all three qualities of color: hue, saturation, and brightness.

Hue. The *linear distance* from a point on one wave of light to the corresponding point on the next wave is its *wave length*. When we speak of Dick's suit as "blue" and his tie as "red," we are discriminating between these colors on the basis of the different lengths of the light waves reflected from those articles of clothing. Thus wave length is the physical stimulus, and hue is the resulting sensation. Dick's tie reflects light waves of greater length than does his suit. Wave lengths of light are so small that we generally measure them in units of millionths of a millimeter ($m\mu$). The visible spectrum—the band of hues to which we have color sensitivity—ranges from violet ($385\ m\mu$) to red ($760\ m\mu$). It can be produced by passing a beam of white light through a prism.

Some hues seem to be more "fundamental" than others—that is, we cannot visually break them down into two or more component hues. The yellows, blues, greens, and reds seem more stable than the oranges, purples, yellow-greens,

and blue-greens and resist analysis into anything else. In the orange, however, red and yellow can be seen; in the purple, red and blue; in the blue-green, blue and green; and in the yellow-green, yellow and green.

The four stable, irreducible hues are called *psychological primaries*, because we cannot consciously analyze them into more basic elements. They should not be confused with either the three primary colors of the artist's pigments or the three primary colors of light mixture. Psychological red is not even found in the spectrum of daylight but is produced by adding psychologically primary blue to the red of the spectrum (Dimmick and Hubbard, 1939).

Saturation. When we speak of Dick's suit as a dull, grayish blue, we mean that the color is not highly saturated with blue. The rich red of his tie, on the other hand, is a saturated color. In terms of light waves, the saturation of a color is determined by the complexity of the light waves emanating from an object. The light waves coming from the dull-blue suit contain not only waves which would produce the sensation of blue hue but also some other waves which, by themselves, would produce a gray. Thus the color appears relatively unsaturated.

Brightness. Still a third quality of color is shown in the striped dress worn by Barbara. The three colors of the stripes all appear quite different: one is pink (a light shade or "tint" of red), the second a rose color (a medium shade of red), and the third maroon (a dark red). Since the stripes are all of the same hue and the same degree of saturation, they differ only in the amount of brightness—that is, they differ from one another in the same way that light gray differs from dark gray.

Other factors also influence the brightness of a color. One of these is the intensity of the illumination. For instance, when you look at an object under a bright light, the apparent brightness of the color is increased. And in illumination too dim for the cones to function—where colored objects appear gray—blue or green objects may be seen as a brighter gray than yellow ones. This is an example of the Purkinje effect, mentioned on page 261. In bright light, yellow seems brighter than a blue of the same physical intensity because the cones are more sensitive to yellow than to blue and green.

The classification of color sensations in terms of brightness, saturation, and hue is by no means all-inclusive. Visual sensations have other characteristics such as a glow or luster, bulk, and surface quality. These are called *modes of appearance*.

The color solid. The three qualities of color and the relationships between them are shown in the three-dimensional *color solid*, which has one dimension to represent hue, a second for saturation, and a third for brightness. The color solid is a double cone shaped much like a child's top. A photograph of it appears on Color Plate I, and the dimensions it represents are indicated in the diagram. ♦ All combinations of hue, saturation, and brightness lie within its boundaries. Points along the circumference represent the different hues, while points along the vertical axis represent degrees of brightness. Toward the upper end of the solid, the colors become lighter and lighter until white is reached. Black, as the darkest color, is at the lower end of the axis. At the outer edge where the circumference is greatest, the colors are saturated. They become less and less saturated toward the center. Thus we can say that points along any radius of the color solid represent degrees of saturation. You can see this clearly by examining the vertical cross section of the color solid shown on Color Plate I. At the center of the cone there is gray, and all along the central vertical axis are found shades of gray, representing zero saturation. The brightest and darkest colors are also the least saturated, so that the very brightest and darkest points, at the top and bottom of the color solid, are also points of zero saturation—that is, they fall on the vertical axis. This is why the color solid is a double cone, tapering to a point at top and bottom. Also, the highly saturated colors are of medium brightness. So, at the midpoint of the up-and-down brightness axis, the color solid is widest, with the greatest range in saturation from the center to the outer rim.

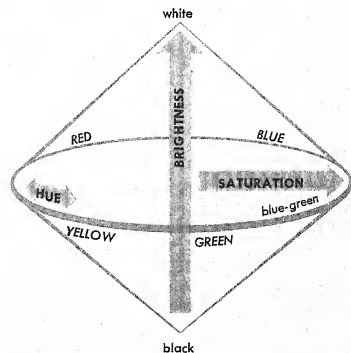
A horizontal cross section is known as a *color wheel*; it is particularly useful in showing relations between hues. As shown on Color Plate I, the various hues are represented by segments around the rim of the wheel, ranging from red to violet. All the hues shown here are found in

the spectrum except for the purples, which must be produced by combining spectral lights. Of course, these pictures are simplified; in reality the colors merge gradually into each other around the wheel. A complete cross section would show them becoming grayer toward the center of the wheel, which is also the central axis of the double cone.

The laws of color mixture. What happens when two hues are combined? This question is not as simple as it sounds, for there are several ways in which colors can be combined.

First, a distinction must be made between combining colored lights and combining or mixing pigments. The laws of light mixture are sometimes the same as, and sometimes quite different from, those of paint and dye mixing. As a child, you doubtless discovered that by mixing blue and yellow water colors you could get green for painting grass or trees. Suppose, however, that you are now on a lighting crew for a college play and you need a green light. Remembering your earlier experience, you try mixing blue and yellow light and are baffled at getting not green but gray. The reason for such different results is complex. Briefly, it is a mat-

♦ THE COLOR SOLID



ter of whether wave lengths are added or subtracted. When blue and yellow *pigments* are mixed, all the wave lengths are absorbed by the paint except those which give rise to a sensation of green. Thus, when we mix pigments, many wave lengths are *subtracted* through this process of absorption. But when blue and yellow *lights* are mixed, they are *added* together.

You cannot obtain your green light by mixing other colors of light because green, together with red and blue, is one of the primary colors of light. This means that these three colors cannot be derived from any other color but that they can, when mixed in different proportions, produce all other colors. The primary colors of pigment are red, blue, and yellow.

There are two simple laws of additive color mixture which describe the results of mixing lights of the same brightness but of differing hue:

1. Any two hues opposite each other on the color wheel combine to produce gray. Examples of such combination are: yellow fused with blue; red-blue fused with green; red fused with blue-green. Two colors which combine to give gray or white are called *complementary colors*.

2. Other hues combine to produce different hues or blends. The result is always a hue which lies between the original hues on the color wheel. For example, red fuses with yellow to produce orange.

To find the results of the mixture of any two colors, you could draw a line from one to the other on a color wheel. The midpoint of the line would show the hue that results when these two colors are mixed in equal proportions. For example, the center of a line passing from yellow to blue would fall at the hub; these two complementary colors fuse to give gray or white. When the hues are not mixed in equal proportion, the resultant hue and saturation correspond not to the midpoint but to the point that accords with the relative proportions of the two colors used.

The degree of saturation of the resulting combination can also be determined roughly from the color wheel if the saturations of the colors being combined are known. For instance, the midpoint of a line from saturated green to saturated red would fall on a yellow of low saturation.

A color wheel, since it is a cross section of the color cone, contains only two of the three "dimensions" of color: hue and saturation. It can summarize only the results of mixing hues of differing saturation but identical brightness. When the third dimension of brightness is added, the problem becomes more complex. Here you have to imagine identifying the position of two hues in the color solid and drawing a line between them.

Contrast effects and after sensations. If a strip of gray paper is placed on a yellow background, the gray appears bluish. If the same piece of gray paper is placed on a blue background, it will take on a yellowish cast. The apparent change of hue is known as *simultaneous hue contrast*. The gray paper always appears to take on the complementary hue of the color in the background. *Simultaneous brightness contrast* effects, similar to those of hue, can also be simply produced. A gray figure against a light background seems darker than the same gray figure against a dark field (see p. 7). All such contrast effects are called "simultaneous" because the original hue (or brightness) and the contrasting hue (or brightness) are seen by the eye at the same time.

After sensations or *afterimages* are so called because a second color sensation follows the original color sensation. If the second color is a hue complementary to the original, it is called a *negative after sensation*. For example, gaze steadily at a bit of yellow paper, not allowing your eyes to waver. The borders of the paper will soon take on a bluish tinge. The yellow itself seems to fade, to lose saturation. After these effects are clearly observable, look at a piece of white paper and you will see a patch of blue, which is complementary to yellow.

A negative after sensation such as this will mix with a currently perceived color to give results predictable through the regular laws of color mixture. For example, if the blue after-sensation is projected onto orange paper, the orange of the paper and the blue of the negative after-sensation will combine to give red-purple.

An interesting contrast effect is produced by looking intently at a surface of a particular hue and then gazing at a surface of complementary

hue. In this case the second hue is seen as more saturated than it would normally be. In fact, the fullest saturations are obtainable only by first looking at the complementary hue.

Aftersensations of the original rather than the complementary hue may also occur after an interval of stimulation. These are called *positive aftersensations*. For an example, gaze at an electric light for a time and then blank it out with a piece of paper. For a short time the light will appear to glow before you.

Naming colors and naming by colors. We have seen that the human eye is capable of discriminating more than seven million colors. However, this superb sensitivity may largely be wasted unless the color sensations perceived can be adequately named and classified. The problem of recognizing colors has great practical importance today, because complex information systems often use colors in coding information. It is important that the colors used for this purpose be so distinct as to cause no confusion with each other and that they be readily identified by a common color name known to the untrained individual. Seven colors of this kind would be of greater practical use than seven million inadequately named colors. It would probably be impossible ever to name the whole seven million shades of color, since many of them represent tiny differences perceptible on a comparative basis only. The individual can perceive that this pink is slightly brighter than that, for example, but if only one of the two is presented to him he can see only that it is a bright pink. When an absolute judgment of this kind is made rather than a comparative judgment, a tremendous shrinkage in the number of identifiable colors occurs. Even then, considerable inconsistency is found among individuals in their naming of colors. That is, what one person consistently regards as pure yellow will be consistently seen by another as yellowish orange or greenish yellow. Whether the difference is in actual color perception or in naming habits is not known. Color experts differ in their terminology, sometimes on the simplest colors. For example, what is *red* to an artist is *red magenta* to a color photographer.

To further complicate the situation, a vast number of names are used in business and in-

dustrial, partly to achieve "new names for old colors every year" so that the consumer will discard her "shocking pink" dress because "mad magenta" is the fashionable shade for the current season. Among the 5000 color terms listed in a dictionary prepared for the National Bureau of Standards for 1955 are *afterglow*, *air castle blue*, *angel red*, *Australian pine*, and *autumn blonde*, as a small sample of those beginning with A. These color names alone convey little meaning. Unless you have seen the particular shade of red attributed to angels, you may mentally picture the hue as anywhere from a pinkish shade to a deep orange red. Many less specific color names, not coined for a particular season, such as *alabaster*, *claret*, *heliotrope*, *carmine*, *madder*, or *fuchsia*, are also used. These are usually not clearly defined in most people's minds, if indeed the terms are in their vocabulary at all.

On the other hand, the number of color names in common use by persons in other fields than merchandising is exceedingly small. Even novelists, who are concerned with full and exact descriptions, use a limited number of terms to designate colors. In a survey of seventeen best-selling books, it was found that twelve terms comprised 92.4 per cent of the color designations used. Arranged in order of most to least often used, they were: white, black, blue, red, gray, green, brown, gold, yellow, pink, silver, and purple. Moreover, only 7.9 per cent of these terms were modified by such words as "pale," "dark," "grayish," etc. (Evans, 1948).

In an attempt to find some middle ground between the paucity of commonly used color names and the plethora of commercially advertised colors, a study was conducted to find out what consistencies and what differences exist in the way people really use color names.

A total of 1359 color chips were prepared and displayed (not more than 550 at a time) to the subjects, twenty young men and twenty young women. A total of 233 color names were tested. These included basic color names presented both alone and with modifiers. Colors were presented in groups. For example, those in the yellow, brown, and orange group were displayed at once, the subject being given names such as *vivid brown*, *pale orange*, etc., and asked to select the color chip which best exemplified each name.

The consistency of the selections made varied considerably with different colors. Observers never agreed completely in their selections for any color name, nor did they ever disagree completely. Women were significantly more consistent in their selections than men. As would be expected, high consistency was shown for white, gray, and black color names. Subjects were also quite consistent in their choices for orange, yellow, red, green, and blue, although they showed considerable variability for purple and violet. Olive was the color for which variability was greatest. Less consistency was shown for compound colors, such as yellow-green, than for simple color names. Consistencies were greatest for color names which implied high saturation—vivid red, strong orange, or pure blue. In fact, these three modifiers were evidently regarded as synonymous by the observers. Likewise, they made no distinction between *pale* and *light* or between *deep* and *dark*. Agreement was poorest for the modifiers—gray or grayish, as, for example, in reddish gray or grayish red. The observers tended to see fewer color differences than are recognized by color experts. For instance, experts think of yellowish green as being quite different from greenish yellow, but the observers scarcely differentiated between these two colors at all. They saw little difference between violet and purple, tending to reverse the expert opinion that violet should be closer to blue than purple is.

The results of the study indicated that there were 45 color names for which color selections would not overlap. However, 246 of the color chips, or 18 per cent, were never selected at all. The investigator estimated that a theoretical total of about 55 color names would be needed to cover all of color space in a meaningful way (Chapanis, 1965).

In spite of the huge number of possible color names, the small number in everyday use, and the inconsistencies in individual concepts of even the simplest colors, it is still efficient to *name by colors*. That is, it is easier to classify certain items by colors than by words or numbers. The human factors department of a large manufacturer of electronic equipment conducted a study to determine whether it is more efficient to label wires by number or by color. Both systems are in use.

Subjects experienced in sorting wires by number were asked to sort sixty wires which go into the assembly of a piece of complex radar equipment. These wires were identified by numbers of one, two, or three digits. They

were also asked to sort wires on the basis of color code. The color code included such devices as striping as well as hue. It was found that the color-coded wires could be sorted twice as fast as the number-coded wires, and the accuracy was equal for the two methods of coding (Harris, Kolesnik, and Teel, 1964).

As is true of many experiments done in an everyday setting rather than in a laboratory, this was not perfectly controlled; there were sixty numbered wires and only fifty-five color-coded wires, suggesting a slight advantage to the color-coding system. On the other hand, the subjects were experienced electronics assemblers who had had more experience working with number-coded wires. Despite these factors, the obtained difference in the efficiency of sorting under the two types of coding is great enough to suggest that there is a real difference and that manufacturers would do well to adopt a system of color coding.

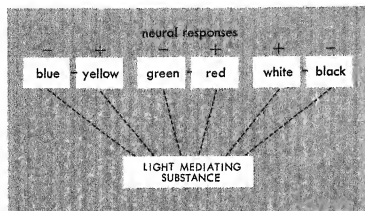
Theories of color vision. Although a number of theories have been advanced to explain how the cones enable us to see color, none of them can account for all the phenomena of color vision. Perhaps the most widely known is the *Young-Helmholtz theory*, proposed by Thomas Young in 1801 and later modified by Hermann von Helmholtz. According to this theory, the human eye contains three kinds of cones, each kind being sensitive to one of the three primary colors of light. When all are stimulated equally, a sensation of white results. Other color sensations result from combined stimulation of the three types of cones in different proportions. This theory accounts for the observed fact that different mixtures of wave lengths yield different color sensations.

Certain aspects of the Young-Helmholtz theory have been proved erroneous. For instance, Helmholtz believed that specific nerve fibers and specific areas of the cortex were activated by specific color responses in the cones, but this has been shown to be false. Modern research does, however, bear out the view that different types of cones are responsible for different color sensations. The physiological evidence is reasonably conclusive that there are three kinds of pigments in the cones of the human retina. There is no doubt that this is the

case in chickens, whose retinas are very rich in cones and so very poor in rods that these animals are virtually blind at night.

A modern *opponent-process* theory of color vision is based on this evidence and on the assumption that black and white are true color qualities and not just the presence or absence of light (Hurvich and Jameson, 1957). This new theory is a restatement and clarification of an older one, the Hering theory, which lapsed in acceptance for a time because the Young-Helmholtz theory appeared to be simpler. But as facts have accumulated, it is beginning to appear that the Hering theory is more adequate after all.

The basic schema for the opponent-process is shown in the diagram. ▲ Three pairs of neural processes—yellow-blue, red-green, and white-black—are postulated. Each of these neural systems is capable of two modes of response that are opposed in nature, and the sensory qualities associated with each pair are mutually exclusive. Thus we may experience the sensation of red-blue or green-blue but never yellow-blue. According to this theory, the visual system reaches a state of equilibrium when no external visual stimulus is present; this state is the correlate of gray.



Adapted from Hurvich and Jameson, 1957

▲ THE OPPONENT-PROCESS THEORY OF COLOR VISION

This diagram shows the three paired opponent response systems postulated. According to the theory, a given stimulus can activate the process for either blue or yellow, for example, but not for both simultaneously.

Recently reported work adds further evidence in favor of the opponent-process theory of color vision. Investigators using the single-unit technique described on page 265 have found that the center-surround relationship of the neural mechanisms involved is that which would be expected on the basis of the theory (Wiesel and Hubel, 1964).

Color Blindness

The essential difference between color-blind and normal persons is that hues which appear different to the normal person look the same to the color blind. John Dalton, the eminent British chemist, was the first to recognize this defect. Color blind himself, he described his sensations of color in 1794, stating that blood looked to him "not unlike the color called bottle green."

Color-blind persons frequently do not know that they suffer a defect of vision unless they have been tested and informed of the result. They see all the objects that other persons see and have learned to call those objects by the same color names that others use. Furthermore, color blindness is not an all-or-nothing condition. People vary from strong color vision through many degrees of what might be called "color weakness" to the very rare state of complete color blindness. Probably about 5 per cent of men suffer some degree of color weakness, but only about one woman in a thousand does so. Interestingly enough, however, a man's color blindness is transmitted through his daughter (in recessive form) to any sons she may have.

The classification of color blindness is far from perfect. The principal defect in current systems is that they fail to measure and express the various degrees of color blindness in sufficiently fine categories. The standard procedure is to consider that there are two kinds of color blindness: *total color blindness* and *dichromatic color vision*.

Total color blindness. Total color blindness is extremely rare, occurring in one among 40,000 people. To date, only a few dozen such cases have been described in scientific literature. It is

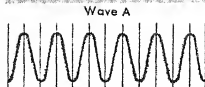
believed that this defect arises from a complete lack of cones in the retina, so that totally color-blind persons must rely entirely on their rods for both day and night vision. This lack of cones shows itself in the fact that such persons are usually completely blind in the fovea, ordinarily the area of greatest color sensitivity. In examining an object, they have to keep shifting their gaze in order to prevent the image from falling on their blind foveal area. Totally color-blind people are highly sensitive to light—so much so that bright light causes them intense discomfort.

Dichromatic color vision. The word *dichromat* comes from two Greek words: *di* meaning

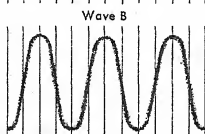
Starting with this frequency you have a certain pitch.



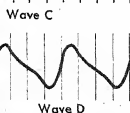
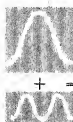
Increase the frequency and you get a higher pitch.



Increase the amplitude and you get a louder tone.



To Wave A add a wave of lower amplitude and twice the frequency. You get Wave D, which has the same pitch as Wave A but a different timbre.



■ PROPERTIES OF SOUND WAVES

The diagram shows the wave properties which produce pitch, loudness, and timbre. Wave B has twice the frequency of the Wave A and hence is higher in pitch; Wave C has twice the amplitude or height of the Wave A and therefore is louder. The addition of a weaker and higher wave to the Wave A produces the complex Wave D.

“two” and *chroma* meaning “color.” A *dichromat* is a person who has normal vision for two primary colors, usually yellow and blue. He sees these in all degrees of saturation and can also distinguish white through all shades of gray to, and including, black. He has a color weakness or color blindness, however, for shades of red or green or both. Obviously such a person suffers a severe limitation of visual ability in comparison to the normal person. Red and green traffic lights used to be confused by dichromats, but now that blue has been added to the green and orange added to the red, the dichromat can tell the lights apart. The different intensity and position of the red, yellow, and green lights give the color-deficient person further clues. Many persons who have a dichromatic color weakness can distinguish reds and greens of high saturation and have difficulty only with pale, less saturated colors.

Testing for color blindness. One of the simplest tests of color vision is the yarn-matching test, in which the subject is asked to match yarns on the basis of color. The person with red-green blindness, for example, can be detected when he sorts red and green tufts of yarn into the same pile. Although this test has the advantage of simplicity, it is subject to error because the yarns differ from each other in brightness as well as in hue and often can be matched on the basis of brightness. The fact that the yarns fade and lose saturation also adds to the difficulty of keeping the test standard. A more satisfactory variant of the matching test makes use of metal chips coated with nonfading plastic paint.

A simple device that shows immediately which colors are confused by the different types of color defectives has been invented by Lt. Comdr. Dean Farnsworth of the Navy's Medical Research Laboratory at the New London Submarine Base (Farnsworth, Sperling, and Kimble, 1949). A person who is extremely color deficient will match a gray spot on a transparent disk with a red, violet, or green spot on a master diagram beneath. Others, not quite so color deficient, will say that the gray doesn't really match any of the spots but looks closer in hue to one of them. In this way the device indicates which colors the observer confuses.

Most color vision tests in use today are similar to those illustrated in Color Plate II. Each plate contains patterns made up of hundreds of colored dots. Figures that stand out from the background for individuals with normal color vision are unseen or misread by the color blind.

Can color blindness be cured? Some people have claimed that Vitamin A has cured their color blindness. Unfortunately, although Vitamin A is known to improve visual acuity and night vision in cases of vitamin deficiency, it has no proven effect on color blindness. It is possible, however, that some partially color-blind people have been able to pass a color-vision test after taking Vitamin A because of increased visual acuity, which can sometimes make a difference in borderline cases.

Another factor which must be considered is that doctors do not agree perfectly in interpreting the results of an examination for color

vision. In fact, one study of the experience of the Civil Aeronautics Authority with civilian pilot candidates found that 50 per cent of the candidates rejected for color blindness by the first examiner were accepted by a second examiner working independently (Viteles, 1944).

A third complication is the fact that practice in taking a test may improve ability to pass it without changing the basic ability to see differences in hues. The subject may memorize, for example, what he "should" see on the test plates. "Color-vision trainers" also make use of the phenomena of simultaneous contrast effects and after-sensations. It is possible with a red-green color-weak retina to bring up the saturation of the red by staring at green, its complementary color, or its near complement.

Present evidence indicates that it is best to restrain any enthusiasm for "cures" of color blindness until careful research has revealed more about its varieties and causes.

HEARING—THE SENSE OF SOUND

In our contemporary culture in the United States and Canada, the possession of a hi-fi set is an important status symbol. To some people the "best that money can buy" is worth the extra cost. Yet to most of us—and our friends—the most expensive sets available are indistinguishable from well selected medium-priced sets. This is the case because our ears are just not good enough to hear the difference. In this section we shall explore what we can and cannot hear and some of the reasons why.

Physical and Psychological Bases of Sound

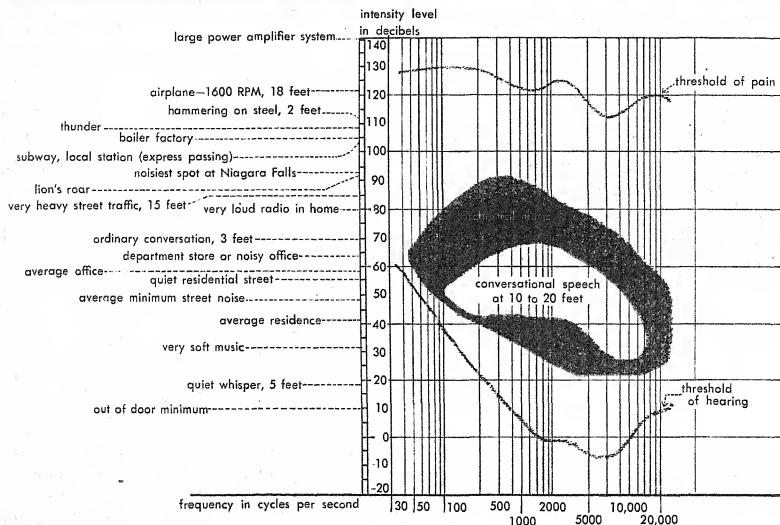
When an object produces sound, its surfaces vibrate rapidly back and forth, creating waves of *pressure differences* in the surrounding air. These alternating waves of dense and thin air are the stimuli for hearing. As the object vi-

brates in one direction, it pushes against the surrounding air and compresses it; in the other direction, the object moves away from the air and thus tends to thin it. As the vibrations continue, this cycle repeats itself and the alternating high- and low-pressure areas—or sound waves—are directed away from the object at the speed of eleven hundred feet per second. Only the pressure areas move; the air particles themselves remain almost stationary.

The sound waves produced by the vibrations of an object vary in their *frequency*, *amplitude*, and *complexity*. These three aspects of the auditory stimulus produce corresponding dimensions of sound: *pitch*, *volume*, and *timbre*. ■

Pitch. Pitch refers to how high or low a note sounds. It is related primarily to the *frequency* of vibrations and is expressed in *cycles per second* (cps). Each piano string, for example, has

LOUDNESS OF FAMILIAR SOUNDS



a characteristic rate of vibration when struck—faster for the shorter strings, slower for the longer ones. A string vibrating at around 16 cycles per second produces a sound as low as the human ear can hear. The highest notes man can hear are produced by vibrations at around 20,000 cycles per second. These figures are for loud tones only; our range of hearing decreases as loudness decreases.

Different species vary considerably in the range of frequencies to which they are sensitive. A dog, for example, can hear higher tones than a man; utilizing this principle, a high-pitched dog whistle has been marketed that is inaudible to humans. A porpoise can hear tones *four times higher* than those a human being can hear (Kellogg, 1961).

Volume. Volume, or loudness, is determined primarily by the amount of pressure *difference* between the compressed part of the wave and the rarefied part. It is the aspect of an auditory sensation which we describe in the terms “weak” and “strong.” Volume also depends partly on frequency because there is typically a lower threshold to high frequencies than to low ones. Thus a high tone of low amplitude may actually sound as loud as a lower tone of greater amplitude.

A sound stimulus may be so weak that it will not produce any auditory sensation whatever; we refer to such a sound as being below the threshold of hearing. At the other extreme, a sound stimulus may be so strong that the resulting sensation is one of pain rather than

hearing. The range of pressures to which our ears are sensitive is immense. The ratio of the least to the greatest is about 1 to 5,000,000. Because of the large range of actual sound pressures, auditory intensity is usually measured in a logarithmic unit known as the *decibel* (db). The decibel measures the intensity of a particular sound in terms of *how many times more intense* it is than a sound at the lower threshold of hearing. Since this threshold depends not only on the amplitude of the sound waves but also on their frequency, zero on the decibel scale has been fixed to represent the least intense stimulus we can hear at a frequency of 1000 cycles per second.

The chart shows on a decibel scale the comparative loudness of many familiar sounds. Although the threshold of pain is not reached until 115 to 130 decibels, sounds above about 80 decibels are unpleasant for most people. The threshold of pain, like that of hearing, depends on both the intensity and the frequency of the sound waves.

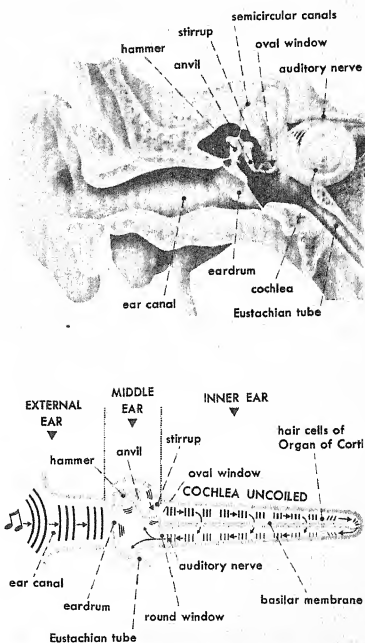
Timbre. Most tones are complex rather than pure. In a musical tone, the fundamental tone is combined with weaker ones called *overtones*. A wire four feet long, for example, will vibrate as a four-foot wire to produce its fundamental pitch. But it will also vibrate simultaneously as two two-foot wires—each such vibration producing other tones far less audible than the fundamental one. To a much lesser extent, it will vibrate as four one-foot wires, producing even fainter sounds. These overtones (also called *partials* and *harmonics*) are included in the audible tone and help to make up its quality, or *timbre*. The difference in quality between middle C on a flute and on a violin results from differences in the complexity and arrangement of the overtones that each instrument produces because of its material and design and the manner in which it is played.

The sound waves produced by a musical instrument, though complex, repeat themselves in a regular pattern. The auditory sensation created by such regular waves is a pleasant one. Many objects, however, produce waves of irregular and unrelated frequencies. This results in the sensation of *noise*, sometimes defined as "unwanted sound."

The Hearing Mechanism

To understand the sense of hearing, we must know something of the anatomy of the ear. The drawings show the structure of the various parts of the human ear.

Pressure fronts into nerve impulses. Before nerve impulses can travel to the auditory center



STRUCTURES OF THE HUMAN EAR

The top drawing is a cross section of the human ear. Below it is a diagrammatic cross section with the cochlea as it would appear if it were unwound and stretched out straight.

of the brain, sound waves must pass through three principal parts of the ear: (1) the external ear, (2) the middle ear, and (3) the inner ear, or *labyrinth*, where these sound waves are finally transformed into nerve impulses.

1. The waves of pressure travel first through the outer ear and auditory canal to the thin membrane called the *eardrum*.

2. The eardrum is pushed and pulled by the pressure waves. It in turn transmits the motion to three hinged bones—the *malleus* (hammer), the *incus* (anvil), and the *stapes* (stirrup)—located in the air-filled cavity of the middle ear. This cavity is supplied with air by the Eustachian tube, which leads in from the throat and makes it possible for the individual, by swallowing, to equalize the pressure on the two sides of the eardrum. If this is not done during descent in an airplane, hearing is temporarily impaired. The movements of the stirrup are transmitted to the *oval window*, a membrane separating the middle and inner ears.

3. Vibration of the oval window forces movement of the fluid in the upper *cochlear canals*. The movement of the fluid, in turn, pushes the basilar membrane up and down; this excites the hair cells of the *Organ of Corti* lying on the basilar membrane. The movement of the hair cells stimulates nerve impulses in the fibers associated with the hairs; finally, these impulses travel through the *auditory nerve* to the brain, where they are translated into the sensation of hearing.

The basilar membrane varies in width from one end to the other (being narrowest, strangely enough at the wide end of the cochlea), and different areas along it respond maximally to vibrations of different frequencies. How a nonmetallic structure can respond differently to such a wide range of frequencies has long puzzled physiologists. This membrane is extremely sensitive, and moves a distance about equal to the diameter of a hydrogen atom.

Nerve impulses into sensations. How does the inner ear signal the frequency and amplitude of the auditory stimulus to the brain so that both pitch and loudness can be recognized? One explanation of this was the *place theory* set forth by Helmholtz around the turn of the century. The transverse fibers of the basilar membrane

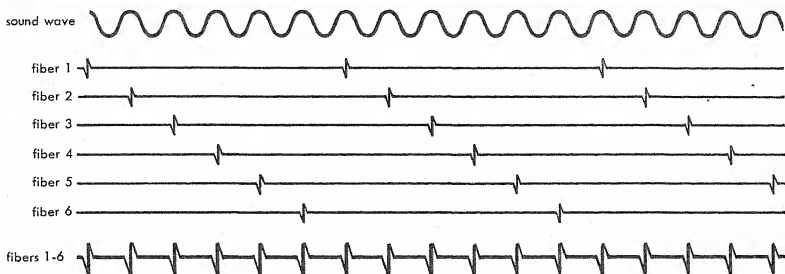
were thought to be a series of resonating strings tuned to different frequencies, like the strings of a piano. Helmholtz believed that a particular tone would cause a particular fiber of the membrane to vibrate and excite the receptor cell at that point and this in turn would give rise to impulses in particular nerve fibers going to a particular band in the cerebral cortex. The place theory is familiarly called the “pitch is which” theory—that is, pitch is determined by which fiber is stimulated. Intensity of the stimulus, according to the Helmholtz theory, is indicated by how often the nerve fiber responds.

It is now known that the transverse fibers in the basilar membrane are not separate strings. In fact, direct visualization of the basilar membrane suggests that it is not, as the Helmholtz theory assumes, under transverse tension (Békésy, 1957). Physical principles other than resonance explain how different points on the basilar membrane can be maximally stimulated by different frequencies.

A given tone activates a considerable extent of the basilar membrane, and it is known that few private paths to the brain exist. However, there are combinations of facilitation and inhibition within the brain which sharpen the transmission and make a place theory still tenable. Georg von Békésy, a Nobel prize winner, has demonstrated such a combination on the human skin and has termed it *funneling*. He placed five vibrators in a row on the forearm, all vibrating with apparently equal intensity when presented alone but each having a different frequency. When all vibrated simultaneously, only the frequency of the middle vibrator was perceived. But although the frequencies of the other vibrators were lost, they still contributed to the intensity of the felt vibration. Apparently, there was inhibition of the main pathways from the end vibrators but facilitation of the impulses from the center vibrator, just as though all the impulses had been funneled into a narrow channel from the center vibrator (Békésy, 1958). Here we have another example of a ring of inhibition around a core of excited fibers in the nervous system.

Even with funneling, the place theory meets some difficulties with the low tones. Some of the *frequency theories* that have been developed do a better job of explaining the hearing

VOLLEY THEORY



Based on Wever, 1949

of low tones. Typical of these was the *telephone* theory suggested by the British physicist, Ernest Rutherford, to account for the whole range of hearing. He held that the frequency of nerve impulses was directly correlated with the frequency of the sound wave. Thus the basilar membrane was thought to play a role similar to that of the telephone transmitter, sending impulses at various frequencies to the brain. This theory held that the loudness of an auditory sensation was determined by the number of nerve fibers excited, which in turn depended on the amplitude of the original sound wave. But a single nerve fiber can respond for any length of time no more than 600 times per second. Obviously, then, it cannot transmit all the frequencies within the range of hearing, for these may be as high as 20,000 cycles per second.

A theory which supplements the telephone theory is the *volley* theory, first developed around 1930 (Wever and Bray, 1930). To explain the fact that we can hear frequencies much higher than the maximum frequency of nerve fiber discharge, it was suggested that the nerve fibers operate in groups and that the various groups react—or discharge their volleys of impulses—at different times. If a tone of 4000 cycles per second were being transmitted, for example, there would be a spurt of activity in the auditory nerve every four-thousandth of a

second, or once for every peak in the sound wave—but different groups of fibers would be responsible for the spurt each time. Some fibers might react to every fourth cycle of the sound wave, some to every fifth cycle, some to every sixth, and still others even less often.

The latest evidence seems to indicate that combination of a volley theory and a place theory is needed to explain hearing. For frequencies up to 5000 cycles the volley principle seems to be the major factor, but above 5000 cycles the experience of pitch can be explained only by the place principle (Wever, 1949). The great precision with which man can distinguish between different pitches has also made it increasingly clear that further shaping of auditory input must be provided by complex circuits in the central nervous system.

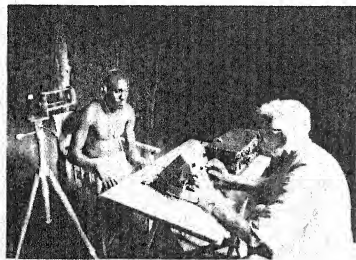
The auditory area of the brain. From the receptor cells in the inner ear, chains of nerve fibers lead to a relay station in the thalamus. From here, neurons continue upward to the auditory area of the cortex, located in the lower wall of the fissure of Sylvius (p. 55). About as many fibers go from each ear to the cortical area on the same side of the brain as go to the cortical area on the opposite side. For this reason, destruction of this area on one side reduces hearing ability only slightly.

We now have some idea of the manner in which the brain functions in producing the conscious qualities of auditory sensation, especially pitch. Different fibers in the auditory nerve and different areas in the auditory cortex respond to high, low, and intermediate pitches.

Does this mean that the "pitch is which" arrangement applies right up to the cortex? Actually, pitches very close together in frequency can be distinguished even after the cortical auditory area associated with them has been removed from both sides of the brain. This indicates that the "pitch is which" statement probably applies to a station in the auditory pathway below the cortex. The auditory areas of the cerebral cortex apparently contribute the finer points of hearing, such as the ability to localize sounds and to distinguish patterns of sound.

Deafness

Although we usually think of deafness simply as inability to hear, there are different kinds of deafness.



Recent studies of Mabaan tribesmen suggest that the loss of hearing of high notes with age noted in Americans and Europeans and thought to be universal may be the result of environmental factors. Mabaan tribesmen in Sudan suffer no such loss: their hearing is as keen at 75 years of age as at 15 and is the keenest of any group so far tested. The loud noises to which we are accustomed are unknown to them: their ordinary day brings sounds no louder than the call of a bird.

Every sound has a characteristic pattern by which it can be identified. Those of a wolf whistle and of the words "visible speech" are shown here. "Reading" these patterns enables the deaf person to catch the differences in timing and emphasis which add emotional content to speech.

Wolf whistle



"Visible speech"



Intensity deafness. Many people are "hard of hearing" in the sense that they cannot detect faint sounds that are easily heard by normal persons. Intensity deafness is often an occupational disease. Pilots and boilermakers, for example, often become partially deaf from the loud noises to which they are constantly subjected. Many gunners and mortarmen of World War II and the Korean War suffered hearing losses in the higher ranges, accompanied by more or less permanent ringing in the ears (*tinnitus*).

Physiologists have shown that the ear can protect itself from noise damage. Two of the smallest muscles of the body are attached to the chain of bones that conducts sound through the middle ear. Sound causes a reflex contraction of these muscles, cutting down the amount of sound that can reach (and damage) the Organ of Corti. This *acoustic reflex* is protective and comparable to the blinking and pupillary reflexes of the eye. It occurs too slowly, however, to protect the ear from sudden explosive sounds. It has been discovered that the occurrence of hearing loss and ringing in the ears is decreased among gunners if a 1000 cycle 98 db tone is sounded before a burst of machine-

gun fire. (Fletcher and Riopelle, 1960). Yawning and swallowing will also trigger the acoustic reflex.

Whether or not the ears are damaged by loud noises, their sensitivity to the higher frequencies generally decreases progressively with age. Hearing specialists have discovered that each year after a person reaches the age of twenty-five, he must sound a high note on the piano with 25 per cent more energy in order to get the same sensation of loudness that he did the year before. The upper threshold of hearing drops with age; children can hear higher frequencies than adults. ■

One of the common causes of deafness in young people is an interference with the conduction through the middle ear as a result of infection or of having the tiny stirrup bone sealed tight in the oval window. An individual so afflicted hears better through the bones of his head than through the middle ear.

Fortunately, few people have complete intensity deafness. For the less seriously handicapped, there are various kinds of hearing aids that amplify sounds until they can be heard fairly easily. Even where the defect is too severe to be overcome in this way, the individual may

have some auditory sensitivity that can be used. In most cases, for example, children classified as "totally deaf" have some hearing. They may be taught the meaning of words through the use of a powerful amplifier which can deliver, with virtually no distortion, up to 130 decibels (much louder than is comfortable for a person with normal hearing). The children learn how to speak by imitating these sounds, and can then be taught to read lips.

The sense of sight can help compensate for a hearing loss even without face-to-face contact. Techniques developed by the Bell Telephone Laboratories make it possible to analyze a human voice electronically and present it as a series of patterns on a fluorescent screen which a deaf person can "read" as the words are spoken. *

Tone deafness. People who are unable to tell one note from another are known as *tone deaf*. Ability to differentiate between tones is not, of course, an all-or-none condition. People vary in their sensitiveness to differences in pitch. There is a limit, evidently set by the individual's ear structure, on the pitch discriminations he can learn to make.

THE SOMATIC SENSES

In contrast to the two "long-range" senses of sight and hearing, which gather precise information about the environment from long distances, man's somatic (body) senses are much less accurate and depend upon direct contact. There are four somatic senses whose receptor cells are located in the skin: *pressure* (touch), *pain*, *cold*, and *warmth*. These are sometimes called the *cutaneous senses* (skin senses). Each of these tells the organism something different about the external world.

There are two more somatic senses that are intimately connected with each other and cooperate to maintain bodily balance and to inform us of the positions of our arms, legs, head, and

all movable parts. These are the *kinesthetic* and *labyrinthine senses*.

Pressure

The sense of touch is of great use to individuals who do fine work of any sort. Engravers at the Bureau of Engraving and Printing have traditionally used their hands to wipe ink from the printing plates and can feel accurately just how much to wipe off. In fact, human sensitivity to pressure is delicate enough to detect a film of grease that may be only one layer of molecules thick.

All of us use the sense of pressure every day to verify what our eyes tell us. Something may look like wood, but we rub it to make sure it is not plastic. A fabric may look like silk, but the best way to tell is to feel it. The sense of touch gives the blind a partial substitute for their lost vision. They can "read" by means of the Braille system (so named after its French inventor), which uses different patterns of raised dots to indicate all the letters and punctuation used in printing.

The average person is likely to think that every point on the surface of his body is equally sensitive to pressure. Actually, pressure sensitivity exists in tiny spots surrounded by relatively insensitive areas. The richness with which a given portion of skin is endowed with pressure spots determines the sensitivity of that region and there are wide differences in sensitivity over the body. The ball of the thumb, for example, has about 135 pressure-sensitive spots in each square centimeter of its surface; the back of the hand, 30; and the upper arm, 10. The number of these pressure-sensitive spots which can be located by systematic application of a stimulus varies with the strength of the stimulus, since some spots have a higher threshold of sensitivity than others (Guilford and Lovewell, 1936).

As already mentioned (p. 258), the pressure sense is subject to adaptation effects. If a gentle pressure is maintained constantly, you soon become unaware of it. After wearing a ring for some minutes, for example, you cannot tell whether you have it on except by looking at your hand or by moving your hand so that the ring stimulates new areas of the skin.

Pain

The obvious biological value of pain in protecting us from bodily injury has led to the popular belief that pain always accompanies injury and that the amount of pain suffered is directly proportional to the degree of injury. As you will see, there is some truth in this belief but there are also many exceptions. Reports on people who are born without the ability to feel pain convince us of the utility of pain as an adaptive device (Sternbach, 1963). In childhood such persons typically sustain extensive

burns and bruises and it is only with great difficulty that they learn not to inflict injuries upon themselves.

Pain-sensitive spots are located by pressing the skin with a fine-pointed needle. Pain, like the other cutaneous senses, shows a point distribution rather than a continuous one. Pain spots are much more numerous, have a different distribution, and reach their highest concentration in different areas than pressure-sensitive spots. The number of pain spots per square centimeter of body surface is about 50 on the sole of the foot; 60 on the ball of the thumb; 170 on the eyelid; 230 on the neck. Physicians draw small blood samples from the ball of the thumb because that area is relatively insensitive to pain.

Each part of the body surface is supplied with pain receptors which come into play only when a stimulus is strong enough to bring about actual tissue injury. The same type of stimulus at lower intensities would not affect these receptors. Usually the pain precedes actual destruction, so that its warning helps us avoid the danger. This is not always so, however, as anyone who has had a bad case of sunburn can testify.

The tissues inside the body have few pain nerve fibers as compared with the outer surface. Certain internal organs such as the liver, spleen, and kidneys can be cut, crushed, or burned without causing pain. The adaptive significance of this differential sensitivity is easily seen. Our sensitive outer skin warns us of injury, making us avoid situations in which internal injuries might be encountered. By the time a wound reaches the inside of the body, it is usually too late for a warning of danger to be useful. The internal organs are, however, sensitive to strong degrees of natural stimulation—distension and contractions (cramps).

Excessively strong stimulation of many kinds produces pain. The intensity of the light from an electric arc is painful to the eyes if continued for only a few seconds. Excessively hot or cold objects are painful to the skin. Loud sounds hurt the ear. This is not because neural impulses from a nonpain receptor are converted into pain-producing impulses but because receptors for pain are found even in the special sense organs.

Pain occurs in response to even mild stimuli when the body is exceptionally sensitive (a condition known as *hyperalgesia*). Occupations that demand unvarying positions during work often produce neck and arm pains. Muscles kept in steady contraction cause excruciating pain. Many of the frightening pains which send people to the doctor are simply muscle pains due to contraction of muscles from chronic "nervous" tension. Finally, pain is sometimes experienced at a location quite distant from the area actually being hurt (*referred pain*).

Some pains are actually considered pleasant. The gratifying reaction to horseradish and hot spices is believed due to activation of pain receptors.

Pain sensitivity varies from situation to situation. Football players, prize fighters, and other athletes have been known to receive serious injuries without awareness of any pain. Indeed, they have sometimes been totally unaware of any injury. When attention is diverted from a painful stimulus, the pain is diminished or even disappears. Conversely, it has been shown experimentally that if the subject's attention is focused on a potentially painful experience, he will feel greater pain than he would normally. The simple reading of the word "pain" lowered the pain threshold of anxious subjects in the reporting of the pain from an electric shock (Hall and Stride, 1954). Experiments at the U.S. Public Health Service Hospital in Lexington, Kentucky, have shown also that if the subject is told that he has complete control over a pain-producing stimulus, the stimulus is reported to be far less painful than when the source of it is not under the person's control (Melzack, 1961).

The effect of suggestion on amount of pain experienced has been explored in studies of surgery cases in hospitals. In one study it was found that while 75 per cent of patients in severe pain could be relieved by large doses of morphine, 35 per cent could be relieved by the injection of an inert sugar or salt solution which they believed was a pain-killing drug (Beecher, 1959). Thus a large part of the drug's effect is apparently due to suggestion.

Related studies have shown that the *meaning* of the injury is very important in determining its painfulness.

The same investigator found that among soldiers who were severely wounded in battle only one out of three claimed enough pain to request morphine. In contrast to this, four out of five civilians whose surgical incisions matched the soldiers' wounds claimed to be in severe pain and demanded morphine. The investigator's explanation was that to the civilian, the surgery means expense, lost time, and disruption of the good life, but to the soldier, the wound of equal severity means honorable escape alive from the battlefield (Beecher, 1959).

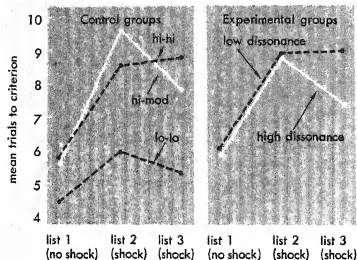
That even the same individual may feel different amounts of pain in response to the same stimulus, depending on its meaning to him, has been shown in an ingenious experiment.

The subjects, eighty male undergraduates, all learned one list of words without shock and two comparable lists while being given electric shocks under varying conditions. Three subgroups functioned as control groups to show the effects of differing degrees of shock on learning. One of these was given a low shock throughout the learning of Lists 2 and 3 (lo-lo), another was given two severe shocks during both lists (hi-hi), and the third was given severe shocks during List 2 and moderate shocks during List 3 (hi-mod). As might be expected, interference with learning was directly proportional to the degree of shock: least for the lo-lo group, greatest for the hi-hi group, and less on List 3 than on List 2 for the hi-mod group.

After learning List 2, the experimental subjects, who had been led to believe that the experiment was now over, were given a choice of either going home or volunteering to remain and learn a third list with the same shock as before. Half of this group were given several possible justifications for staying (importance of the experiment to science, to the space program, etc.). No such justifications were suggested to the others. It was predicted that those who felt they were staying with good justification would feel only minimum dissonance (inconsistency) in choosing to undergo more pain, and hence that their learning would show the same pattern of interference as that of the hi-hi control group, whose behavior was presumably primarily under the control of the physical intensity of the shock. By contrast, it was predicted that the subjects who stayed without any such justifications for doing so would feel a sharp dissonance in choosing to undergo severe pain for no good reason and that they would need to reinterpret the situation to lessen the discrepancy.

MEANING AND THE PERCEPTION OF PAIN

Although both experimental groups were given the same high degree of shock during both Lists 2 and 3, their learning performance on List 3 was very different. The performance of the low-dissonance group continued to be directly proportional to the degree of shock given, but the high-dissonance group, with a good reason for feeling less pain, believed that the pain was less and learned as if it were.



Based on Zimbardo et al., 1966

As shown in the graphs, these predictions were borne out by the results. ♦ The learning performance of the low-dissonance group was virtually identical with that of the hi-hi control group, whereas that of the high-dissonance group showed the same reduction in interference in the learning of List 3 as did the hi-mod control group, whose intensity of shock was actually reduced. Many of the subjects in this experimental group also reported feeling less pain. Responses to a questionnaire indicated that the low-dissonance group regarded the experiment as significantly more important than did the other experimental group (Zimbardo, Cohen, Weisenberg, Dworkin, and Firestone, 1966).

We shall examine the effects of this sort of dissonance further in Chapter 10.

Cross-cultural studies have shown that the perception of pain varies greatly from culture to culture. In our culture, for example, childbirth is regarded as a painful experience. In one African culture, by contrast, a woman continues to work in the fields until the child is about to be born. The husband then gets into bed and groans as though he were in great pain while

she bears the child. He stays in bed with the baby to recover from the terrible ordeal he has just gone through, while the mother almost immediately returns to tending the crops. This evidence does not indicate that women in the two cultures differ physiologically from one another but suggests that they differ psychologically. Women in our culture have been taught since childhood that childbirth is painful and may endanger the life of the mother, and thus a fear is instilled in young girls as they grow up. Such fear can increase the amount of pain actually experienced (Melzack, 1961).

Reactions to pain seem to be different among different subcultures. Jews and Italians have been found to exaggerate pain, while the Irish and those of old American stock minimize it (Zborowski, 1952).

Cold and Warmth

Physically, cold and warmth are simply degrees of the same thing—heat. But physiologically they are quite different. When the same area of the skin is mapped for warmth and cold, we see that the two sets of spots—those stimulated by the addition of heat and those stimulated by the loss of heat—do not coincide. Recording the electrical activity of single axons reveals that some are active when skin temperature is lowered, others when it is raised. This indicates that warmth receptors are separate from cold receptors—that is, the receptors are *functionally* specific. The receptors underlying warmth, cold, and pain spots may not be *structurally* different, however.

Suppose you go into a room on a summer day when the thermometer reads 90 degrees. There are several objects lying on the table—a water glass, a metal letter opener, a woolen scarf. You hold each one of these objects against your perspiring cheek and observe that the glass and the metal letter opener seem cold, whereas the woolen scarf feels warm. All these objects are actually at the same temperature, since they are all in the same room; but glass and metal absorb your body heat and so “cool off” your skin, whereas wool prevents body heat from escaping and keeps your skin feeling warm. Thus the effective stimulus to the temperature senses is the *addition or subtraction* of heat.

Neither type of receptor is stimulated by objects which are at the same temperature as the skin itself—usually about 90° Fahrenheit. Hence this temperature is known as the *psychological zero point* or *point of indifference*. The indifference point does not remain exactly constant, however. To test this, dip your left hand for a few minutes into water at 80 degrees and your right hand into water at 100 degrees. After a short time, your hands will feel neither warmth nor cold. A new psychological zero point has been reached and the receptors are no longer activated—sensory adaptation has taken place in each hand. Now plunge both hands into water at the usual indifference point of 90 degrees. It will seem warm to the left hand and cool to the right one.

Cold-sensitive spots normally are stimulated by temperatures below the psychological zero point. They give no response at all to temperatures ranging between this point and about 110° Fahrenheit. But interestingly enough, cold-sensitive spots respond to temperatures above 110 degrees with an intense sensation of cold. This is called *paradoxical cold*. A similar phenomenon of *paradoxical warmth* is obtained when warmth-sensitive spots are stimulated by objects sufficiently below the psychological zero point.

The psychological experience of *heat* apparently is not merely one of extreme warmth. Rather, it seems to be a synthetic experience aroused by the simultaneous stimulation of both warmth- and pain-sensitive spots.

The Kinesthetic Sense

Close your eyes and relax your body. Have someone place your arm in a certain position. Without looking at it, you have no trouble duplicating the position with your other arm. Now let your friend move your arm slowly, bending it at the elbow through a small arc. Notice that this gives rise to definite sensations of movement. The receptors which produce these sensations of movement—kinesthetic sensations—are located in the muscles, tendons, and joints of the body. When the parts of the body move, these receptors are stimulated by stretch and pressure, giving rise to kinesthesia.

The kinesthetic sense is the most important sense in determining and controlling both body position and movement. It plays a major role in maintaining an erect posture, walking, talking, and performing any motor skill.

Much of what we call "touch" involves muscle sense as well as pressure. The so-called "feeling" of velvet or silk, as contrasted with oil or glass or sandpaper, is composed partly of the muscle sensations produced by different degrees of resistance to the movement of our skin over the surface.

The Labyrinthine Sense

Every individual is aware of changes in his body position even when they are not the result of conscious effort or muscular contraction. An astronaut experiencing weightlessness will know every time his head changes position, even though he may not have moved it himself. The receptors involved in giving you a cue to body position when no muscular activity is involved are located in the *labyrinth*, or inner ear. Within the bony labyrinth are the *semicircular canals*—three loops extending in three different planes (p. 279). These receptors are called the *labyrinthine* or *vestibular* receptors, and their function is to keep you informed of your position in space—whether you are moving up or down, right or left, backward or forward. When your body's motion in space is accelerating or decelerating, hair cells in the *ampullae*—swellings at the base of the semicircular canals—are the chief receptors stimulated. These hairs are activated by movement of the liquid in the canals; their bending, in turn, stimulates associated nerve fibers. Similar receptors in the *saccul*e and *utricle*, two saclike chambers in the vestibule at the base of the canals, respond to the static force of gravity and to straight-line motion.

The sense of movement in space is related to the unpleasant phenomenon of "motion sickness." We know that the labyrinth is the organ involved in motion sickness, for people and animals with no vestibular sensitivity do not experience it. For many people, however, the sensation is a common one, occurring most frequently in airplanes, ships, autos, streetcars, and trains, in that order.

Effective physiological stimuli for producing motion sickness are: rotation (especially in more than one plane), vertical movements, change of head position in relation to body position, and certain visual stimuli during motion. Wavelike motions are particularly nauseating when they are of intermediate size and frequency; large or small waves, or very quick or slow ones, are not so likely to make us feel sick. There are many other causes of nausea, of course, such as certain drugs, physical illnesses, and unpleasant odors, which do not involve the semicircular canals.

Perhaps the most interesting psychological cause of motion sickness is the experiencing of incongruous sets of sensations. The labyrinthine sense is stimulated only when the body stops or starts in space. On a quiet day, an airplane (even when flying close to the earth) gives the passenger no labyrinthine or kinesthetic stimulation. He might just as well be sitting in a comfortable chair at home as far as sense of movement is concerned, and no nausea will occur if he either closes his eyes or confines his visual field to the interior of the plane. But if he looks out of the window at the earth rushing past at 300 miles per hour, he may very well get sick, for he is not accustomed to seeing the earth move past him when he has no sensation of movement.

If the plane is bouncing around, on the other hand, it is best for the passenger to close his eyes. If he looks at the interior of the plane, he will feel the sensation of falling without seeing himself falling past anything. This is another incongruous sensation and will tend to produce nausea. To prevent motion sickness, an individual must be able to organize his sensations into a meaningful and consistent pattern.

Other psychological factors in motion sickness are suggestion, emotional condition, and conditioning by past experience. Reduction of motion sickness occurs by habituation to the stimuli causing sickness, by lying down, or by taking certain drugs.

Somesthesia and the Brain

The areas of the brain involved in sensory functioning are shown in the diagram on page

58. The part of the cerebral cortex most concerned with kinesthesia and the cutaneous senses lies just back of the fissure of Rolando. This is the *primary somatosensory area*. The body surface is "projected" onto this area just as it is onto the motor areas, with the left side of the body being represented on the right side of the brain. Just below this area is a *secondary somatosensory area*, in which the representation is in reverse order and not so precise and to which many of the messages come from the same side of the body and from the thalamus. This area also extends across the fissure of Rolando; thus it is largely coextensive with the secondary motor area.

When destruction occurs in these somatosensory areas—especially in the primary one—there are losses of cutaneous and kinesthetic perception. He cannot tell where an object is touching him; he will be aware merely of an unlocalized pressure. He can still feel pain, and he can tell the difference between very warm and very cold objects, but he cannot distinguish between grades of warmth and cold. With his eyes closed, he cannot tell the position of his arms or legs or how they are being moved by someone else. He can handle objects, for he retains the power of movement, but he cannot tell you whether it is a key or a coin that he is handling unless he looks at it. He cannot tell sandpaper from silk, although he may report that one seems pleasant and the other unpleasant to the touch.

If the primary area on one side of the brain is destroyed, sensory ability is affected only on the other side of the body. The only exception to this is the face, which has some representation on the same side. If only a part of the primary area is destroyed, the impairment is limited to a part of the body.

The unlocalized sensitivity remaining when the somatosensory areas are destroyed is due to the action of the thalamus, which is located in the older part of the brain. In lower animals having a small cerebral cortex, this area is responsible for nearly all sensation. In man, although most of the sensory function has been taken over by the cerebral cortex, the bare recognition of the kind of stimulation and feelings of pleasure or discomfort are still controlled by the thalamus.

THE CHEMICAL SENSES

There are two important senses in which the receptors are stimulated by chemical substances. These are the *olfactory* sense (smell) and the *gustatory* sense (taste).

The Olfactory Sense

The olfactory sense, like each of the other senses, provides a means of getting information about the environment. Although for most of us the sense of smell does little more than add to life's enjoyment or discomfort, it is indispensable to survival among many wild animals. A deer, for example, might detect the presence of a cougar either by seeing it, or, at night, by hearing it. But if the cougar were lying motionless on a branch overhanging a salt lick, the sense of smell would be the only means of detecting it. For some species, it is the most highly developed sense.

Many primitive peoples make greater use of the sense of smell than civilized man, who rarely uses it to its full capacity. The Chukchee tribe of Siberia, for example, make exceedingly fine discriminations between odors and describe many objects in terms of smell which we would describe in terms of appearance or texture. They even greet each other by sniffing behind the ear (Odulok, 1934).

The receptors which function in olfactory sensation are located in the upper passages of the nose and are stimulated when chemical substances in vapor form are inhaled. There is considerable confusion regarding the number of fundamental qualities of smell. One traditional system for classifying odors has six classes: spicy, burnt, resinous, flowery, fruity, and putrid. Another system lists only four classes: acid, burnt, fragrant, and caproic (goaty). It is impossible to tell whether any of these qualities has a separate receptor, because the location of the olfactory receptors in the nose makes it impossible to map the sensitive areas as we can those for pain, pressure, warmth, and cold. Nor do we know just what happens in these recep-

tors when we experience the sensation of smell. It seems probable that they react chemically to the vaporous substances.

There are great individual differences in the odors people consider pleasant or unpleasant, although in general any odor is unpleasant if it is too intense. Many people find the heavy scent of flowers in a florist's shop to be unpleasant. Psychological conditioning seems to play a large part in determining whether or not we like a particular odor (McCord and Withridge, 1949). Indeed, fashions in smell have varied throughout history. In the seventeenth century, for example, people liked the odor of spices and resins and probably would have been as disgusted by our present-day perfumes as we would be by their spices, which only half disguised less pleasant odors that we now take the trouble to obliterate or prevent.

The art of obliterating odors has become a major industry. Often unpleasant smells can be washed out with water or absorbed by activated carbon. Much-lauded chlorophyll has been proved ineffective as a deodorizer, but some compounds can neutralize offensive smells by canceling them. For example, cedar wood cancels the smell of rubber. Really effective deodorizers of the air are "anesthetics" of the olfactory receptors.

Fortunately, our olfactory receptors become adapted to odors in many instances, so that even the foulest stench or the most permeating aroma soon becomes less noticeable. Another interesting phenomenon is that when we are concentrating on other matters, we often are unconscious of odors. Sheer imagination also can affect our sense of smell, as shown in a study in which 300 college girls were used as subjects.

Samples of popular brands of perfume or toilet water were used, as well as distilled water for a control. Samples were presented to the subjects on blotting paper or in a special instrument known as an olfactometer. Each girl was asked to sniff two samples; state whether the two scents were the same or different; and, if dif-

ferent, decide which she preferred. Actually the two samples were identical in every case.

Among the subjects who were given identical samples of perfume to smell, 38 per cent decided that the two samples were different; of those who smelled only distilled water, 17 per cent found a difference in the samples. Although most of those who expressed a preference for one of the two samples preferred one only slightly more than the other, as many as 13 per cent claimed to prefer one sample "very much" (Eisensohn, Fischelli, and Welch, 1954).

In view of the millions of dollars that are spent each year for perfumes, surprisingly little scientific work has been done to discover the factors determining preference for scents. Methodological problems such as the great difficulty of controlling experimental conditions are among the reasons for the relative unpopularity of this area of research.

Very little is known about the brain mechanisms for the chemical senses. Nerve fibers from the olfactory patches of the nostrils connect eventually with the oldest part of the cerebral cortex, the rhinencephalon (p. 56). In tracking olfactory impulses electrophysiologically, all trace of them is quickly lost. Only the anterior (front) portion of the rhinencephalon can be safely associated with olfaction; the remainder is concerned with emotion, motivation, and perhaps learning. Fibers from the olfactory patches also lead to other parts of the hindbrain, where they set up connections making possible reflex responses to smell stimuli.

The Gustatory Sense

The receptor cells of the sense of taste are activated through some sort of chemical stimulation by the material tasted. These receptors are located in clusters called *taste buds*. The newborn baby has his full quota of taste buds. As the individual passes middle age, however, there is a marked tendency for the number of sensitive taste buds to decline. Older people who complain that their meals taste flat are not merely hard to please; they are unable to taste as well as they once could (Arey, Tremaine, and Monzingo, 1935). There is evidence that

in some very old people, taste sensitivity disappears completely.

Smoking reduces taste sensitivity temporarily (Sinnot and Rauth, 1937). For this reason most gourmet clubs will not permit smoking during their dinners.

There are four elemental qualities of taste—sweet, sour, bitter, and salt. Sour-sensitive spots are located mainly along the sides of the tongue; sweet-sensitive spots along the tip; bitter-sensitive spots at the base; and salt-sensitive spots on the tip and sides.

When the same substance activates two different sets of receptors, each gives rise to its own characteristic sensation. Saccharine is sweet when tasted on the tip of the tongue and bitter when tasted at the base.

The taste buds are apparently activated by extreme cold as well as by chemical stimulation. This was mentioned by Charles Horvath (1956) in a description of his experiences on a scientific expedition near the North Pole. He stated that if he opened his mouth when it was 60° below zero he could literally *taste* the "bitter cold." He likened the sensation to having a rag soaked in alum stuffed down his throat.

What we call "taste" in food is determined in part by smell, by sensations of warmth and cold, by cutaneous and kinesthetic impressions, and, in the case of certain types of seasonings, by mild pain. The sense of smell is particularly important in determining flavors. Scientists studying the flavor of the tomato in order to determine how best to preserve it in tomato paste analyzed the odors involved and found that they ranged from "sweet, flowery, and minty," to "rubbery" and "slightly musty." Specific odors analyzed from the tomato included those of rose, violet, lemon, peppermint, caramel, vanilla, sulfur, and citronella (Spencer and Stanley, 1954).

In taste, as in vision, there are *contrast effects*. Lemonade tastes sour if we eat cake first. Similarly, there are *complementary* tastes, a mixture of which tends to neutralize both. Thus sugar takes the sourness out of lemon. Sweet and bitter also tend to neutralize each other. Bitter and sour are complementary to a lesser extent, as are salt and sweet.

The close relationship between smell and taste is reflected in the close cooperation of the

neural mechanisms involved. Our understanding of taste is considerably clearer than our understanding of olfaction, however. For example, we have a fairly good idea of the way that taste receptors sort out and signal to the brain the four qualities of that sensation (Pfaffmann, 1963).

Using the single-unit technique described earlier, experimenters were able to measure the responses of single fibers in the gustatory nerve when a series of taste stimuli were placed on the tongue. These taste stimuli represented each of the four basic qualities. Three types of fiber were found to respond strongly to salt. However, two of these were also moderately responsive to acid. Three types were found to be sensitive to sugar as well as to salt and sour. One of them responded to bitter while the other two did not. Obviously there is no simple relationship. One might suspect that one nerve fiber is serving more than one receptor cell. This is not the case, however, for similar observations of individual receptor cells have yielded the same results (Kimura and Beidler, 1956).

How is taste quality signaled to the brain when the same fiber and receptor can be stimulated by more than one of the four basic types of stimuli? An answer to this question is suggested by another experiment in which two units of the taste nerve were studied.

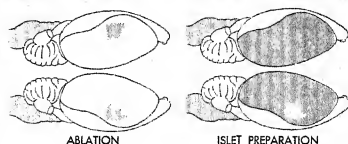
The stimulus intensity of sodium chloride (table salt) and sucrose (table sugar) was measured by counting the frequency with which the fibers responded. Although both fibers responded to both substances, one showed greater sensitivity to sucrose than to sodium chloride, whereas with the other fiber the situation was reversed. Thus this system signals sodium chloride when fiber A responds more intensively than fiber B and sucrose when the reverse is true (Pfaffmann, 1963).

The story of how the taste area in the brain was found is an interesting example of how physiologists and psychologists work.

From theoretical considerations, W. S. Börnstein, a neurologist, concluded that the taste area was not near the olfactory area, as was then believed. He predicted that it would be found instead to be in or near the somatosensory area associated with facial sensitivity (Börnstein, 1940).

▲ THE TASTE AREA IN THE RAT

These diagrams show the localization of the taste area in the two hemispheres of the rat's brain and also illustrate two methods of identifying the cortical areas involved in given sensations. Ablation is a technique by which specific areas are removed from the brain. If both the shaded areas shown in the left diagram are removed, the taste sense disappears. On the other hand, when the whole cortex is removed on one side and all but the taste area on the other side, as shown in the diagram on the right, the animals can still discriminate between tastes. This technique is called *islet preparation*; only a small bit of cortical tissue is left to function.



Other psychologists, using monkeys and chimpanzees, made lesions at the point in the thalamus where touch fibers relay on their way to the cortex. Such lesions resulted in the predicted blunting of taste sensation. But when lesions were made in the cortical areas to which the fibers go after leaving this relay point, there was no serious interference with taste, and the search for the missing cortical area seemed to have met a blank wall (Patton, Ruch, and Walker, 1944).

The next step was to stimulate the taste nerve and record the resulting electrical activity in the cortex of a rat. In this way, the actual area to which the taste nerve sends impulses was identified (Patton and Amassian, 1952). Since the taste nerve contains both taste and touch fibers, however, the area specifically concerned with taste still remained to be mapped. Guided by similar observations on rats, other workers made lesions in the active area, as shown in the first part of the figure, ▲ and found that the rats could then no longer tell the difference between tastes. When this area was left intact and the surrounding area was destroyed, taste sensitivity was unaffected. By comparing the two parts of the diagram, you can see that the results of

the two kinds of extirpation agree perfectly (Benjamin and Pfaffmann, 1955).

The taste area thus identified turned out to be, as Börnstein had predicted, not near the olfactory area but closer to the facial sensitivity area. The location of a specific taste area in monkeys and men is not yet known.

CHAPTER SUMMARY

All knowledge comes to us through our senses. If sensation is to occur, a *stimulus* must activate *receptor cells*, from which nerve impulses travel through the *nervous system* to the sensory areas of the brain. Only stimuli which are above the *threshold*, or *limen*, can activate the receptors. We do not always respond even to the adequate stimuli, however, for much incoming nervous activity is inhibited within the central nervous system. According to *Weber's law*, the smallest perceived difference in stimulus intensity is a constant proportional part of the comparison stimulus. The senses are subject to *adaptation*, which makes them temporarily less sensitive. Sensory experience is remarkably stable over time.

One of the most important of the human senses is vision. Light rays from an object enter the eye through the *pupil* and are focused by the *cornea* and *lens* onto the *retina*, which contains the visual receptor cells. From these, nerve impulses travel via the *optic nerve* to the *occipital* area of the brain. The two kinds of visual receptors are the *cones*, which produce sensations of both hue and brightness, and the *rods*, which produce sensations of brightness only. Images are clearest when visual stimuli strike the *fovea*, in which the cones are densest and in which no rods are present. The function of the cones is to detect color and fine details. During the process of *dark adaptation*, the rods take over the task of seeing; color discrimination disappears but the threshold for seeing is lowered. Sensitivity is lost first to red and yellow and then to blue

and green—the *Purkinje effect*. Light adaptation also occurs.

The eyes make many kinds of movements in focusing on an object. These include *convergence* of the eyes, *accommodation* of the lenses, the *pupillary reflex*, *cyclofusional* movements, *jump* movements when looking at motionless objects, and *pursuit* movements when following moving objects. The last two movements are called *conjugate* movements because the eyes move together.

Visual acuity, sharpness of vision, is determined by the efficiency of the eyeball mechanism and an intricate system of neural structures. Both central and retinal mechanisms help in adapting to different intensities of illumination. The optic nerve fibers from each eye cross at the *optic chiasma* at the base of the brain, so that stimuli from the right side of the visual field are sent to the left hemisphere of the brain. Destruction of the occipital cortex on only one side leads to *hemianopia*. Visual acuity may be defined in terms of the smallest object that can be seen at a standard distance or the minimum distance which must separate two lines for them not to fuse into one line. Common visual defects include *myopia* (near-sightedness), *hyperopia* (far-sightedness), *presbyopia* (old-sightedness), and *astigmatism* (irregular curvature of the cornea), while *diplopia* (double vision) and *scotoma* (blind spot) occur more rarely.

The three chief qualities of color are *hue*, determined by the frequency of light waves; *saturation*, determined by their complexity; and *brightness*, determined by their amplitude. The relationships among these qualities are clearly shown in the *color solid* and the cross-sectional *color wheel*. Any two hues opposite each other on the wheel are called *complementary colors*. In combining colors a distinction must be made between the *additive* mixture of lights and the *subtractive* mixture of pigments. A complementary color sensation may follow an original color sensation; this is known as a *negative after-sensation*. *Positive after-sensations* and *simultaneous hue contrast* also occur. Although there is a vast number of names for shades of color, and these do not always mean the same shade to different people, *naming by colors*, as in color-coding wires, is highly efficient.

The most widely known theory of color vision is the *Young-Helmholtz* theory, according to which the eye has three kinds of cones, each sensitive to one of the three primary colors of light. Recent research, however, tends to give greater support to the more complex *opponent-process* theory.

Although total color blindness is very rare, *dichromatic color vision* is more common, especially in men. This usually involves difficulty in distinguishing reds from greens and may be tested by various devices. To date there is no proven cure.

Sound, like color, has three dimensions: *pitch*, determined by the frequency of the sound waves; *loudness*, determined by the amplitude or intensity of sound pressures; and *timbre*, determined by the complexity of the wave. When sound waves strike the ear, they cause the *eardrum* to vibrate. It in turn transmits the motion to the three hinged bones—*malleus* (hammer), *incus* (anvil), and *stapes* (stirrup)—whose movements cause a vibration of the *oval window*, a membrane between the middle and inner ear. This vibration, in turn, causes movement in the fluid of the *cochlear canal*, exciting the hair cells of the *Organ of Corti*, on the *basilar membrane*. Nerve impulses set up by the hair movement travel through the *auditory nerve* to the brain. The most satisfactory theory of hearing incorporates both the *place* principle for high tones and the *volley* principle for low tones. The auditory area of the brain is located in the lower wall of the fissure of Sylvius. Deafness may take the form of *intensity deafness* or *tone deafness*. The *acoustic reflex* serves as a protective device against damage from intense sound.

The *somatic senses* include the *cutaneous* senses—*pressure*, *pain*, *cold*, and *warmth*—and the *kinesthetic* and *labyrinthine* senses. The

cutaneous senses show a point distribution over the skin rather than a continuous one. Excessively strong stimulation of various kinds may cause pain. The meaning of pain to the individual is important in determining its felt intensity. Neither cold nor warmth receptors are normally stimulated at the *psychological zero point* or *point of indifference*, about 90 degrees Fahrenheit. However, *paradoxical cold* may be experienced at temperatures above 110 degrees and *paradoxical warmth* at relatively low temperatures. Our kinesthetic sensations give us our sense of *position* and *active movement*. In the *semicircular canals* of the *labyrinth*, or inner ear, are found the receptors which detect changes in acceleration or direction of the body. The body surface is “projected” onto the *primary somatosensory area* upside down and onto the *secondary somatosensory area* in the reverse order. Certain unlocalized sensations and feelings of pleasure or discomfort are controlled by the *thalamus*.

The chemical senses are the *olfactory* sense (smell) and the *gustatory* sense (taste). Relatively little scientific work has been done to discover the factors determining preference for certain scents, partly because of the methodological problems involved. Olfactory nerve fibers from the nostrils connect with the anterior portion of the *rhinencephalon*, the oldest part of the cerebral cortex. The four elemental qualities distinguished by the *taste buds* are *sweet*, *sour*, *bitter*, and *salt*. Most “tastes” are actually made up in part of smell and other sensory impressions. Single nerve fibers are often sensitive to more than one elemental taste quality but are more sensitive to one quality than the others. The taste area of the brain is located near the area associated with facial sensitivity rather than near the olfactory area.

Chapter 9

Outline

ATTENTION

ASPECTS OF ATTENTION
ROLE OF THE CENTRAL NERVOUS SYSTEM
THE DIRECTION OF ATTENTION
THE SHIFTING OF ATTENTION
THE PROBLEM OF DISTRACTION

PERCEPTION

FACTORS IN THE STIMULUS FIELD
CHARACTERISTICS OF THE PERCEIVER
SOCIAL FACTORS
ACCURACY OF PERCEPTION
INTERACTION OF THE SENSES

THE PERCEPTION OF SPACE

VISUAL PERCEPTION OF STATIONARY OBJECTS
EXPERIMENTS WITH VISUAL DISTORTION
VISUAL PERCEPTION OF MOTION
LOCATING STATIONARY SOUNDS IN SPACE

THE PERCEPTION OF TIME

ESTIMATING INTERVALS OF TIME
FACTORS AFFECTING PERCEPTION OF TIME

REACTION TIME

MEASURING REACTION TIME
FACTORS INFLUENCING OUR SPEED OF REACTION
PERCEPTION AND VIGILANCE

PERCEPTION UNDER UNUSUAL CONDITIONS

PERCEPTUAL CHANGES AFTER PROLONGED SENSORY DEPRIVATION
EXTRASENSORY PERCEPTION

Chapter 9 Observation and Action

Relatively few of the myriad forces and energies in the world about us ever move us to thought, feeling, or action. Some are "tuned out" by our receptors, which are stimulated only by energies of certain intensities and wave lengths. Some sounds are too high, others too low for the human ear to detect; some pressures are too light to be felt; the human eye cannot respond to wave frequencies above the violet or below the red in the spectrum. For still other stimuli, such as radio waves, we have no sensitivity at all. The potential *physiological sensitivity* of the organism, then, sets one basic limit to what we can know of the world around us. But our observation of the world is also dependent on two other closely related processes—*attention* and *perception*.

ATTENTION

From among the many stimuli which are within range physiologically, we select—and consciously react to—only those that are related to our present needs and interests. For example, when we are deeply involved in an interesting conversation, we usually are not much aware of the temperature and furnishings of the room or the noises of traffic outside. This process of psychological selectivity is known as *attention*.

Aspects of Attention

Most psychologists regard attention as having three interrelated aspects, all of which are part

of a single complex act. Attention is (1) an adjustment of the body and its sense organs, (2) clear and vivid consciousness, and (3) a set toward action.

Attention as a postural response. When we attend to something, we adjust the body and its sense organs to receive particular stimuli most readily. When the physician listens with his stethoscope for certain faint sounds in the chest of his patient, his postural adjustment is as complete as is humanly possible. He may even close his eyes to shut out distracting visual stimulation. This is a familiar example of the way we select the significant stimuli from among the many to which our sense organs *could* respond.

Look at the sprinters in the picture on page 297. They are fully alert, their bodies ready for action the moment the starter's gun is heard.

Attention as clearness in consciousness. The method of introspection must be used to illustrate the second aspect of attention. Do you wear glasses? If so, were you noticing the rims just now? Probably not. Yet they are in your field of vision. Look for them and there they are. Is a clock ticking in the room where you are studying or a radio playing softly in the distance? If so, were the sounds vivid in your consciousness a few seconds ago? Probably not. By contrast, if time had been of utmost importance in the situation, not only would you probably have been hearing the ticking of the clock, but it might actually have become subjectively louder and seemed to dominate your whole perceptual field. At any time, some things have the focus of our attention while others, despite equally intense physical stimuli, are on the periphery or not in our awareness at all. It is the

direction of this focus that determines the threshold of effective stimulation.

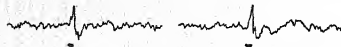
Attention as a set toward action. Attention may also be regarded as a *set*, or readiness to respond in a particular way to some stimulus situation for which there are a variety of possible responses. For example, when the squad leader says "March" (command of execution), the response of his men will depend upon whether the prior command of preparation has been "Forward" or "To the rear." In this sense, set is a motivating condition influencing the *direction* of reaction. As we shall see later in this chapter (page 327), set is also an important variable in determining the *speed* of reaction.

The great Russian physiologist, Pavlov, whose work on conditioning has so influenced the development of American psychology, noted a postural response in his experimental animals similar to the postural aspect of attention in human beings. This he called the *orienting* or *attitudinal reflex*—in Russian, *ustanovychny*. He made no inferences concerning a related state of consciousness, however; like behaviorists since his time, his concern was with observable behavior. The orienting reflex, he noted, played a role in making the animal susceptible to conditioning unless it was either too great or too small, in which case it interfered with the progress of conditioning (Razran, 1961).

Role of the Central Nervous System

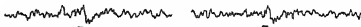
The action of the central nervous system in psychological selectivity can be illustrated by an ingenious experiment with cats.

Measures were taken of the electrical responses in the cochlear nucleus of a cat to clicks of uniform intensity. It was found that when the cat was lying relaxed, the clicks produced a sizable response, as shown in this tracing. (The dots indicate when the clicks occurred.)



When a jar containing two mice was placed in the cage, the cat crouched in front of it, watching the mice intent-

ly. The auditory stimulus was then repeated; this time there was virtually no response, as shown in the tracing below. When the cat was relaxed again, the earlier



responses reappeared. Similar results were obtained using fish odors instead of auditory stimuli (Hernández-Peón, Scherrer, and Jouvett, 1956).

Since the auditory stimuli remained unchanged, the change in response must be attributed to action by the cat's nervous system in selecting some stimuli and suppressing reaction to others.

The notion of incoming messages being transmitted from the sense organs to the brain and outgoing ones from the brain to the muscles is a familiar one. But as we saw in Chapter 2, one of the newly discovered mysteries of the nervous system is that there also are centrifugal or "wrong-way" pathways, which go from the brain down to the relay stations of the sensory pathways. Even the *corticospinal* or *pyramidal tract*—the largest single pathway responsible for voluntary movement—sends fibers to the part of the hindbrain which receives sensory impulses from the skin and muscles. Many parts of the cerebral cortex send descending impulses to the *reticular area* in the brain stem, which relays them to the first synapse of the incoming sensory pathway. The cerebellum, which, like the cerebral cortex, has a strong sensory input, also sends fibers down to the synapses of the sensory pathways.

Altogether the "wrong-way," centrifugal connections are about as extensive and varied as the "right-way," centripetal systems. Furthermore, they go down not only to the first relay station in the central nervous system, but in some cases right out to the sense organ (Hagbarth and Fex, 1959). Thus the behavior of the cats may be explained by the fact that in addition to all the nerve fibers reaching the brain from the ear, a bundle goes from the brain to the ear. This is the "centrifugal auditory pathway," called the *bundle of Oort*. Shocks applied to it cause impulses to go out to the receptor cells in the internal ear and choke off or inhibit the sensory impulses passing along the auditory

nerve to the brain (Calambos, 1956). There seems to be no change in the physical effect of the sound waves on the receptor cells, but the electrical activity in the auditory cortical area is diminished.

That "wrong-way" fibers pass from the brain along the optic nerve to the eye was known in the last century. It was not until a great many years later, however, that investigators learned that activation of these fibers reduces the retina's response to light (Jacobson and Gestring, 1958).

One of the devices used in electronics is a gating circuit, which serves to hold back (inhibit) the flow of current. On a signal, the gate is opened and the current flows for a time; then the gate closes. The "wrong-way" fibers, in blocking the sensory pathways, appear to act like these electronic gates. In the ear, such gating is particularly evident.

With the dozens of forms of energy bombarding the receptor cells of our sense organs every second, it is just as well that we are able to avoid confusion by blocking some of them and "opening the gate" to one stream of impulses at a time. These "wrong-way" fibers enable us to select and attend only to the stimuli which we want or can use, thus preventing us from being passive creatures of our sensory environment. In man, even the protective reflex actions of the spinal cord can be inhibited in this way up to a certain point. For example,

we can voluntarily suppress pain responses and the blink reflex.

The Direction of Attention

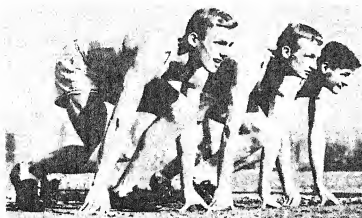
What are the factors that make an object or situation attract our attention? This is a question of enormous practical importance. In advertising or selling, for example, the attention of the prospective buyer must be attracted before he can be sold the product. In education, too, one of the first tasks of the teacher is to win his students' attention, in the broadest sense of that word.

Many factors influence the direction of our attention in a given situation. Some of these, like change and size, are characteristics of the stimulus situation; others, like organic condition and personal interests, are factors that depend on the individual. Usually several of these factors operate together in determining the direction of our attention; the effects of one may wholly or partially cancel out another.

Prepotency. Some stimuli are more potent in attracting attention than others. For example, high sounds are prepotent over low sounds; tickling over broad, smooth pressure; and saturated colors over pastel shades. Such prepotency does not necessarily depend on the relative strength of competing stimuli, nor does it depend upon previous experience.

Change. Change usually attracts attention. Change is movement in any direction: from one place to another; from one intensity to another; from absent to present; from red to green; from high to low; from moving to stationary. The kitten ignores the ball of yarn when it is still but pounces on it when it moves. A sudden shout in the middle of a quiet talk or a whisper from a man who has been shouting makes you "sit up and take notice."

Size. Other things being equal, something large attracts attention better than something small. This is one factor favoring the full-page advertisement. Size, however, is only one of many interrelated factors determining the direction of attention. Even a large advertisement



The posture of these sprinters as they await the sound of the starter's gun defines "attention" better than words ever could.

may suffer by its nearness to another—perhaps smaller—one which appeals more to the reader's interests and needs or has a more striking use of color.

Repetition. A weak stimulus frequently repeated may be as effective as a strong one presented once. But there is a limit to the effectiveness of repetition. If overdone, it can lead to monotony.

Experience shows that repeating a fundamental theme or motif with minor variations is more effective than repeating the original presentation exactly. Many radio and TV commercials are designed on this principle. An effective advertising or political campaign often repeats an essential idea with numerous small variations. Architecture and music also offer many examples of how attention can be maintained by repetition of a central theme with variations.

Organic condition. The stimulus that wins the competition for your attention is usually the one that relates to the strongest biological need operating at the moment. If you are hungry, stimuli related to food will attract your attention. If you are tired, stimuli related to resting will be most effective.

Interests. People vary greatly in their responses to the same stimulation because a person's interests, like his organic condition, predispose him toward a particular response. Suppose that a geologist, a farmer, an artist, and a real estate promoter are looking at the same plot of ground. The geologist's attention may be attracted to the layers of rock exposed where the road has been cut through a hillside. The farmer will probably examine the soil and any plants growing in it. The artist may walk about until he finds a position from which the landscape seems a balanced composition. The real estate promoter may look the property over carefully to see how it could be subdivided. The objective stimulus is the same for all these individuals, but because their interests differ, their attention and behavior vary accordingly.

Social suggestion. In general, people attend to what is pointed out to them. Probably this is

because they have enjoyed many satisfactions and avoided many discomforts or injuries in the past by acting on the suggestions of others. Herein lies the basic explanation of the effectiveness of the following old prank. When you are in a cafeteria line examine the top tray minutely and critically and then take the second tray instead. Usually several others following you in line will also reject the top tray. They are reacting to the suggestion that is implicit in your actions.

The Shifting of Attention

Notice the eyes of a person who is looking at a picture. You will see that they dart here and there, pausing but a short time in any one position. This is typical attentive exploration. The individual's attentive adjustment is not stable and fixed, but shifts constantly from one aspect of a situation to another.

Attention also fluctuates involuntarily, although this phenomenon is not as readily noticed. Hold a watch far enough from your ear so that you can barely hear it tick. Now listen to the ticking, and you will observe that it seems to grow louder, then fades to a point at which it cannot be heard, then grows again, and so on. The period of these fluctuations varies from a fraction of a second to several seconds depending on the individual and the exact conditions of the experiment.

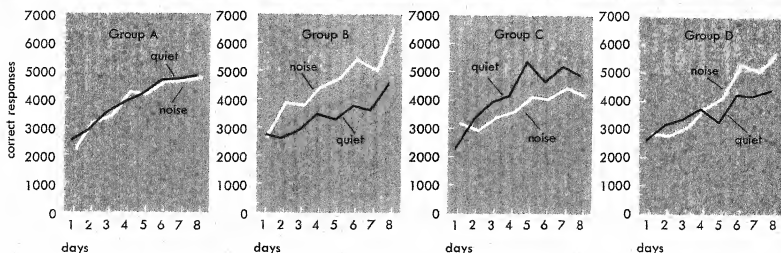
As another simple experiment with this phenomenon, fix your gaze on a faint gray smudge on a blank sheet of white paper. You will observe the same fluctuation in the subjective strength of the sensation aroused.

These experiments demonstrate the important fact that adjustment of the sense organs and attentive adjustment are not entirely the same. You undoubtedly have had the experience of staring at an object without "seeing" it at all.

The Problem of Distraction

Distraction of attention is nothing more than paying attention to something that is not a part of the main activity of the moment. When we

DIFFERING EFFECTS OF NOISE WITH DIFFERENT EXPECTATIONS



Based on Mech, 1953

are distracted, our attention shifts involuntarily. It is almost impossible to ignore completely certain distracting stimuli such as pain, bright lights, and loud sounds; others may or may not bother us so much.

Stimuli that compete for the sense organ already involved in attention are especially distracting. For example, noises would probably interfere with a telephone conversation more than flashing lights would.

The most obvious effect of distraction is reduction in efficiency.

One study measured the cost of distraction in terms of energy required per unit of work. Typists worked on some days surrounded by soundproof partitions and on other days with the partitions removed so that the usual office noises prevailed. Energy cost was measured by having the girls exhale into a specially constructed bag. The expired air was then analyzed to determine the amount of carbon dioxide. From this the consumption of oxygen was computed. The amount of typing accomplished was the same under the two conditions, but the energy cost of the typing done under noisy conditions was decidedly greater (Laird, 1928). These results were confirmed by a later experiment (Freeman, 1939).

Another study indicates that the energy cost of work performed under noisy conditions is greatest immediately after the shift from quiet to noisy surroundings. Apparently a person can become accustomed to noise that is not actually painful (Harmon, 1933).

The effect of noise on the performance of routine tasks depends partly on the individual's "set" or expectation.

Four groups of fifteen subjects each performed simple addition tasks under conditions of quiet and noise for thirty minutes a day over an eight-day period. Their performance on the first day was used as a basis of comparison with the scores made on succeeding days. After the first day each of the groups was given a "set." Group A was simply told that the experiment dealt with the effects of noise on work. Group B was shown a false work graph indicating that in previous experiments subjects had worked better under noisy conditions than under quiet. Group C was shown a false graph which led them to believe that previous subjects had done less well under noisy conditions. Group D saw a false graph indicating that previous subjects had at first performed better under quiet conditions but had gradually become accustomed to the noise until they were working better under noisy conditions.

In subsequent sessions it was found that Group B subjects produced a significantly higher response rate under noisy conditions than did the other groups, whereas Group C had a somewhat higher rate under quiet conditions. Members of Group D gradually increased their response rate under noise, as the graph had suggested they should. Group A, who had been given no particular set, did about as well under noise as under quiet, gradually improving their performance under both conditions during the experiment (Mech, 1953).

In this experimental situation different expectations—internal conditions—influenced the effects of the same external distraction.

Many distractions are internal ones. Worries and fears can intrude to distract us from the work at hand. Research has shown that people who are bothered by many personal problems tend to have more accidents than others (Her-

sey, 1936; O'Connor, 1958). Insurance companies have found that recently divorced persons have more accidents than those same people did before they were divorced.

Physical distractions can often be reduced, but the control of distraction is largely an individual matter. Chronic inattention usually stems from lack of interest.

PERCEPTION

The process of perception stands midway along a continuum from direct sensing to thinking. (In its purest form, sensing does not involve the use of learning based on past experience.) Thinking, at the other end of the continuum, is independent of stimuli from physically present objects; it can be accomplished purely through the use of symbols which represent absent objects and the relationships among them. (Perception uses both sensory data from present stimulation and the learning gained from past experience.) It is through perception that we "make sense" out of the many stimuli impinging on us and maintain the experience of a continuing, stable environment despite the fact that these stimuli are constantly shifting and changing.

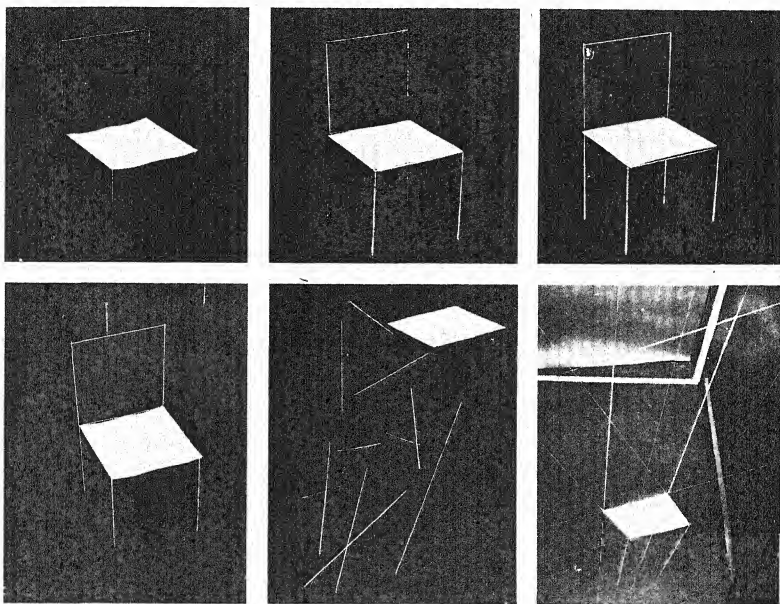
Perception is an active process. Far from being just a mirror whereby we become aware of what is "out there," perception is a process whereby sensory cues and relevant past experience are organized to give us the most structured, meaningful picture possible under the circumstances.) Thus a perception is never just a point-for-point representation of the stimulus field but includes objects, relationships, and points of special focus. Often, in fact, parts of the stimulus field are ignored, distorted, exaggerated, or otherwise changed to make a more stable or meaningful whole. Many so-called illusions are striking demonstrations of the organizing which takes place in all perception. Obviously the task of organizing incoming stimula-

tion is easier if there is clear patterning of the stimuli, or if we have considerable relevant past experience to draw on, or both. But whether we have these aids or not, our brain and nervous system do the best job they can of organizing the incoming stimulation into a stable and meaningful pattern. (What we perceive is always our best guess about what is there on the basis of the available sensory cues and our past experience. Thus perception can be regarded as an active process of choice.)

"In visual perception one is faced with the fact that any given visual stimulus-pattern can be produced by an infinity of different external conditions, and this holds true for both monocular and binocular vision. But we never see an infinity of configurations; we see just one. This means, of course, that perception cannot be 'due to' the physiological stimulus pattern; some physiological stimulus probably is necessary, but it is not sufficient. There must be, in addition, some basis for the organism's 'choosing' one from among the infinity of external conditions to which the pattern might be related. Thus, any notion concerning a unique 'correspondence' between 'percept and object must be abandoned, and a discovery of the factors involved in the 'choosing' activity of the organism becomes the key problem in perceptual theory." (Kilpatrick, 1961, p. 3) •

(Perception not only structures and interprets incoming stimulation) but often fills in missing details. When you look at a sofa, for example, you cannot see all sides of it and perhaps can-

● In a study demonstrating this "choosing" by the organism of one possible percept out of many, subjects looked into each of three peepholes and saw what appeared to be three identical chairs, as shown in the first row of pictures below. When they walked around the screen and looked down on the three "chairs," however, they found that the three very different stimulus objects shown in the second row of pictures had given rise to their original perceptions.



not even see one of the legs; yet you "see" the sofa as being *solid* and *whole*, and you recognize it as the sofa you saw yesterday even though the exact pattern of stimulation on the retina may be quite different. This process of filling in is so common and accepted that we are amused by the anecdote of the skeptic who, when asked the color of a certain cow, said, "It is brown on this side."

An individual's ability to perceive a series of fragments as a whole object depends upon

many factors. The intelligence of the perceiving individual and his mental set—that is, what he *expects* to see—are extremely important. So is past experience.

(Perception is a very personal thing. It enables the individual to know where he stands in relation to the objects, conditions, and people in his environment and to act accordingly.) Even the relationships between one object and another are established in reference to oneself. (Terms such as *right*, *left*, *above*, and *below*, for

◆ To the uninitiated, a pencil seen partly through water and partly through air does not just seem broken—it is broken.



example, are obviously based on the individual's own position as a point of reference.

Our reaction to any situation is determined by the way we perceive it. The same objective situation may be perceived in two quite different ways by two different people or even by the same person at two different times. On your "good days," for example, college and everything about it may seem very satisfying; but on "blue Monday" your classes may seem dull, your food tasteless, and your friends irritating.

Usually we are unaware of the extent to which our assumptions and expectations determine what we see. Instead, perception carries the conviction that what we see is a true and direct representation of reality. Hence the old saying, "Seeing is believing." An *illusion*, or false perception, seems false only when we compare it with what we know to be true. ◆

After many years of research, psychologists still cannot wholly explain how and why isolated incoming "messages" are organized into patterns so that we perceive objects rather than unrelated lines, points, smells, sounds, and bits of color. Nor do we know how much of percep-

tion can be explained by organizing processes in the brain and nervous system and how much is due to learning. The tremendously important role of past learning in most of our everyday perception is obvious. Yet the notion of at least some innate patterning by the brain and nervous system cannot be rejected completely, for there are situations in which individuals give evidence of perceiving pattern and meaning in the absence of any relevant past experience. Evidence of such perception has been provided in an interesting series of experiments with young organisms of various species employing the "visual cliff" device.

This apparatus consists of a board laid across the center of a large sheet of heavy glass which is supported a foot or more above the floor. On one side of this board a sheet of patterned material is placed flush against the underside of the glass so that the glass appears to be as solid as it in fact is. On the other side of the board a sheet of the same material is several feet below the glass. This gives the visual appearance of a drop or "cliff," in spite of the solid glass above it. ■ In experiments with thirty-six infants aged six to fourteen months, each baby was placed on the center board and his mother called to him first from the deep side and then from the shallow side. Twenty-seven of the children tested moved off the board; all of these crawled out on the shallow side at least once, but only three crept off onto the glass above the "cliff." Many cried when the mother called from the cliff side, because they were unwilling to go to her over the apparent chasm; others actually crawled away from her. Some patted the glass on the deep side, ascertaining that it was solid, but still backed away. Apparently they were more dependent upon their visual sensations than upon the evidence of their sense of touch.

Although this experiment does not prove that the infants' perception and avoidance of the chasm are innate, similar experiments with animals tend to support the hypothesis that such perception is inborn. Nearly all animals tested were able to perceive and avoid the visual cliff as soon as they were able to stand or walk. This was true of chicks less than twenty-four hours old, and of kids, lambs, and kittens. Rats felt secure on the deep side as long as they could feel the glass with their whiskers but consistently chose the shallow side when the center board was raised enough to prevent their whiskers from touching the glass (Gibson and Walk, 1960).

In general, these experiments suggest that some prepatting of perception does exist in species whose survival depends upon their being able to perceive depth by the time they can move about on their own.

Although psychologists have barely begun to find answers to many of the "why's" of perception, they have discovered a great deal about the "ways" of perception—that is, about the general laws underlying what is perceived under given conditions. Both factors in the stimulus field and factors in the individual are important in determining what is perceived.

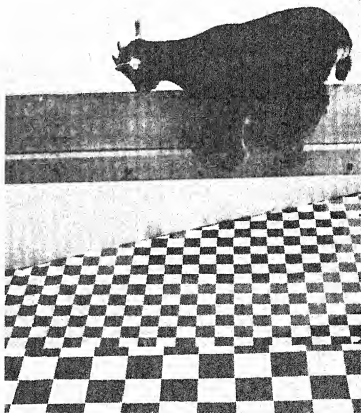
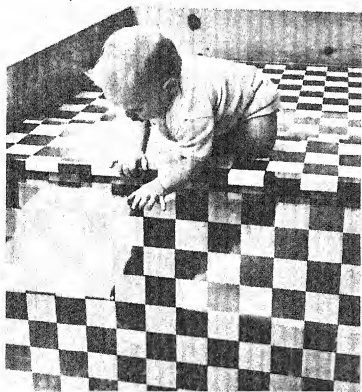
Factors in the Stimulus Field

Among the factors in the stimulus field that influence what we perceive are: nearness, likeness, inclusiveness, closure, and the context.

Nearness. The physical nearness, or *proximity*, of elements to each other makes for their perception as parts of a pattern. Look at the row of dots below. Do you see ten individual dots, or four groups of dots, or some other number of groups? Looked at introspectively, nearness gives rise to the experience of "belongingness." As one psychologist has said in effect, we see or feel "things" and not the holes between them (Koffka, 1935).

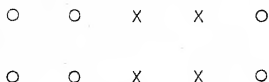


Likeness. Similar elements tend to be perceived as belonging together. Look at the figures at the top of page 304. They are equally spaced; yet they seem to organize themselves into three groups on the basis of similarity. You tend to see squares made up of four X's



These pictures show the apparatus used in the visual cliff experiments and the reactions of two subjects to the apparent drop-off. Although the child patted the glass with his hand and thus had tactual evidence that there was a firm surface there, he refused to crawl across it when his mother called to him. The one-day-old goat walked freely on the shallow side but would not venture out on the deep side. When placed at the far edge of the deep side, he perched carefully on the narrow edge of the board and shortly thereafter leaped across to the shallow side again.

and four circles. You do not see squares made up of two circles and two X's.



Inclusiveness. The pattern which "uses up" all the elements will be more readily perceived than other possibilities. In the figure below you see a hexagonal object formed by all the dots, rather than a square formed by the four middle dots with a single dot at either end.

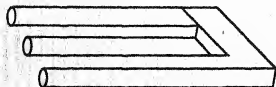


Closure. Not only do we tend to include all available elements in our perception, we may even supply elements which are not present in order to perceive a meaningful whole. Thus the word below can be easily read even though the letters are incomplete. The figure of a man composed of disjointed parts appears to be a man even though the spaces between parts may be rather large. This form of filling in gaps in our perceptions is known as closure.

IMAGE

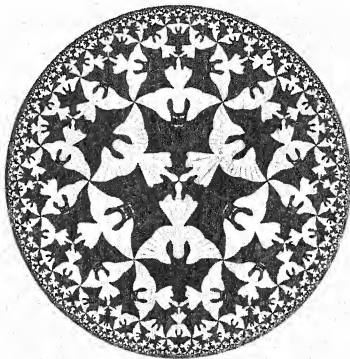
Context. The way the situation as a whole is perceived will influence the meaning of the parts. In some cases, the perception of a particular whole may even involve suppressing or reinterpreting some elements that enter into the perception of a different whole. The picture at the top of page 307 provides a good example.

Look at the drawing below. How many prongs does it have—two or three? What happens to the end of the middle prong when the figure is seen as having only two prongs?



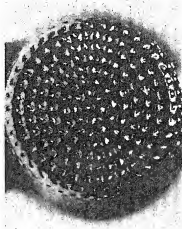
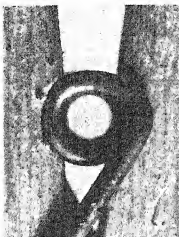
Details of a situation will be perceived in relation to the whole of which they are a part. Without the contextual clues to which we are accustomed, we may find it difficult to recognize even the commonest of objects. Look at these pictures. What are they?

The organization of the visually perceived whole often takes the form of *figure* and *ground*. The figure is the part of the pattern that is most clearly perceived at a given moment, while the rest of the perceptual field becomes ground. When we look at a person or at a piece of furniture in a room, for example, that particular object seems to stand out—or be separate—from the background of the room. Similarly, the words on this page stand out as figures on a white ground. The figure always seems



◆ This is an example of a reversible figure and ground; either the black or the white elements can readily be perceived as the figure. When you are looking at the devils, the angels become background and seem farther away; when you look at the angels, the devils suddenly become background. Even without intending to shift and despite attempts to keep from shifting, you are likely to see one and then the other alternatively as the figure, although in this case, because of the detail in both black and white parts, you may not completely lose the pattern of one figure while focusing on the other.

■ If you do not recognize the objects pictured here, turn to the note on page 307, where they are identified. Then look at the pictures again and you will have no difficulty in "seeing" what they represent.



nerer to the observer than does the ground against which it appears. ♦

The importance of context, or part-whole relationships, is clearly illustrated by our perception of color. We may have trouble identifying the colors of an object unless we know something about the nature of the surrounding illumination. Ordinarily we are not in doubt about this. We know whether a day is cloudy or bright, whether a room is dimly or brightly lighted, whether an object is shadowed or not. In perceiving color we automatically "correct" our sensory impressions according to what we know about the conditions of illumination. Suppose, however, that you look into a specially prepared chamber which contains a disk of dark gray paper, strongly illuminated from a hidden source, and other objects of lighter shade not so strongly illuminated. Under these circumstances the darker disk will appear to be lighter. Similarly, if a piece of gray paper is illuminated by blue light, the subject who is unaware that the illumination is blue will describe the gray paper as blue.

Our surroundings even influence our perceptions of other people, as was indicated by the following interesting experiment.

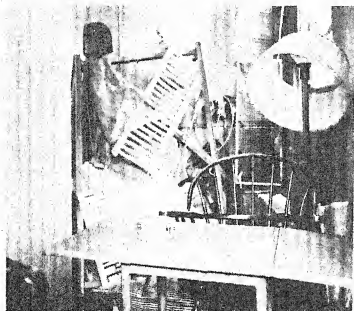
The subjects, ignorant of the real nature of the experiment, were told that the study dealt with the stereotyping of faces. They were given ten photographs of different faces and asked to rate them, using a

six-point scale, as to "energy" and "well-being." Each subject did his rating in one of three rooms: a "beautiful" room attractively furnished and provided with draperies and paintings; a "neutral" room, furnished like an ordinary college classroom or a neat office; or an "ugly" room, resembling an untidy janitor's storeroom.

Each subject was left alone in the room for two minutes so that he could absorb its atmosphere before beginning the task. Those who rated the photographs in the beautiful room gave significantly higher ratings on both well-being and energy than did those in the ugly room. The ratings from the average-room subjects fell between those of the other two groups.

In order that the long-term effects of surroundings could be observed, the two examiners who presented the photographs to the subjects were themselves used as unwitting subjects. Each examiner spent six sessions (one session per day for six days) testing a total of thirty-two subjects. The length of the sessions varied between one and two hours. Each examiner changed to another room each day, spending two sessions in each of the three rooms. At the end of each session the examiners took the photograph test themselves. Like the other subjects, they found more energy and well-being in the faces when they had been working in the beautiful room. Furthermore, the examiners finished their testing more quickly in the ugly room and reported such reactions as fatigue, headache, irritability, and hostility. After a session in the beautiful room, one commented, "I was really beginning to feel like a wheel in there, sitting in a swivel chair and making like a psychologist. It's a lot of fun." He spoke of the other room as the "dungeon." The other examiner

indicated her negative feelings about the ugly room by inadvertently leading a subject into the rest room across the hall at the beginning of one session (Maslow and Mintz, 1956; Mintz, 1956). ■



You have probably had similar experiences of feeling depressed, irritable, and overly critical when your immediate surroundings—or even the weather conditions—were unpleasant.

Below are two of the photographs used in the Maslow and Mintz study, and at the left are pictures of the three rooms that were used. The "ugly" room (top) was filled with "junk" and deliberately made as untidy as possible. The "beautiful" room (center) was comfortable and attractive. The "neutral" room (bottom) was an ordinary campus office.

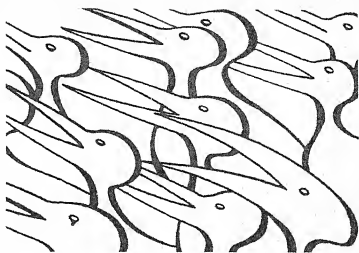


Characteristics of the Perceiver

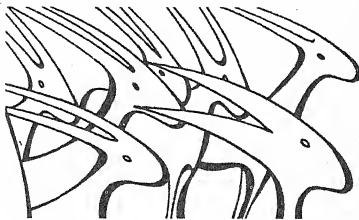
What we perceive depends not only on the characteristics of the stimulus situation but also on our tendency, already mentioned, to try to "make sense" out of incoming stimulation. Thus such individual factors as past experience, organic condition, and personal needs and values are important determinants of what we perceive and often produce striking differences in what two people will perceive in the identical situation.

Previous experience. In no situation is the individual isolated from his previous experience. Therefore, he always perceives his environment not with a blank mind but with an expectancy—or hypothesis—about what he is going to perceive. He is prepared to see, hear, smell, or feel some particular type of thing because preceding events have aroused certain processes of knowledge or motivation. As he receives the actual stimulus from the environment, his perceptual processes enable him to confirm or correct his expectation. If the original hypothesis or expectation is very strong, however, either because it has been confirmed many times in the past or because it is strongly motivated, a contradictory stimulus situation will have to be quite strong to be perceived accurately. Otherwise the individual is likely to "see" what he expected or wanted to see.

Cultural factors of which we are frequently unaware can affect our perceptions. For example, a French industrial expert who visited the United States to observe the American economy and gather ideas for the rebuilding of French industry became more and more dissatisfied as he toured American plants. At last he demanded to know why Americans were so hypocritical, preaching free enterprise when in fact nearly all American industry was nationalized. When he was asked how he had arrived at this erroneous conclusion, he insisted that he had seen it. Pressed to explain how he could see the ownership of a factory, he became less certain but finally realized that what he had seen



For a good example of the importance of context, look at these two pictures. The lower right hand figure in each group is the same, but in one group it looks like a bird in a flock of birds; in the other, an antelope in a herd of antelope.



was the American flag flying over most industrial plants. Since in France it is not customary to fly the flag over privately owned buildings, he had concluded, without consciously working out how, that the American plants over which the flag was flying were government property (Glenn, 1965).

Another example of the influence of an expectancy based on previous experience is seen in the following experiment.

The subjects' task was to match the color of a stimulus patch to one of the colors on a variable color-mixer. In one phase of the experiment the stimuli were pieces of gray paper cut in the shape of a tangerine, a lemon, a neutral oval, a lobster claw, a carrot, a banana, and a neutral elongated ellipse. Each was mounted on blue-green paper and covered with a piece of finely ground

The pictures on page 305 are, from left to right: a spring clothespin, a pair of pliers, a thimble, cellophane tape in a dispenser.

glass. Through simultaneous hue contrast (page 272), the gray patches appeared brownish orange in color. The color-mixer could be shifted from well-saturated red through the oranges to well-saturated yellow.

Starting once from the red position and once from the yellow, the subject was to stop the wheel at the point he thought most nearly coincided with the color of the stimulus patch. As each object appeared, he was told, "This is a tangerine" (or a lemon, or a carrot, etc.). The normally red lobster claw was judged considerably redder and the normally yellow objects considerably more yellow than the other objects. Although some subjects said that they believed all their matches to be the same, their settings actually ranged from a yellowish orange to a reddish orange (Bruner, Postman, and Rodrigues, 1951).

The subjects' perceptual processes had operated to make the stimulus patches appear closer to the customary colors of the objects they represented.

Perceptual bias in another, more life-like, experimental situation shows clearly the influence of labeling.

Photographs of two ordinary looking middle-aged men were shown to 108 executives, mainly in personnel and industrial relations, and 76 members of a Central Labor Council. For half the subjects in each group one photo was identified as that of the secretary-treasurer of a labor union, while the other man was identified as the local manager of a small plant. The other half of both executives and labor leaders saw the same photographs but with the descriptions reversed. Subjects were asked to indicate on an adjective checklist the personality characteristics they saw in the faces of the two men. A great deal of perceptual bias appeared in the results, for the executives checked admirable traits—conscientious, honest, trustworthy, considerate, cooperative, impartial, etc.—as appearing in the pictured face of whichever man they had been led to believe was the plant manager. The labor leaders perceived the union secretary-treasurer to be a similar model of virtue, although to a somewhat lesser extent (Haire, 1955).

Important contributions to our expectations are the basic classifications of experience, gradually acquired since infancy. ▲ Everyone possesses "persistent, deep-rooted, and well-organized classifications of ways of perceiving, thinking, and behaving" (Vernon, 1955). These clas-

▲ Many of our assumptions and expectations we are quite unaware of making. The chances are that you never realized before how implicitly you expect a right-side-up world when you look out the window.



Drawing by W. Miller: © 1962 The New Yorker Magazine, Inc.

sifications are known as *schemata*. They involve the classification of situations of related kinds and also the classification of kinds of behavior appropriate in these situations. Thus your schemata of gardens and flowers would lead you to expect to see roses in a garden at a particular season of the year. These schemata would also enable you to recognize unfamiliar flowers as flowers and cause you to engage in such appropriate behavior as bending over to smell them. Or you might pull a weed, a plant which is inappropriate in the garden.

Machines built to recognize patterns are among the realities of everyday life. Laundromats and other vending machine operations now have change makers that will examine a

dollar bill and issue change if it is a legitimate one. Modern banks have greatly speeded up clearing house operations by the use of machines that recognize (perceive?) account numbers, thus avoiding dependence on human clerks to read signatures. The post office is experimenting with machines which can read zip code numbers and thus process mail much more rapidly and accurately than human sorters. How much farther can machines go in accomplishing human tasks?

Evidence that early experience builds basic schemata even in rats is seen in the experiment already described on page 99, in which young rats were raised in cages with geometric forms on the walls. Later, these rats learned discrimination problems involving the forms more quickly than did animals seeing the forms for the first time. This finding supports the theory that early experience lays down memories that interrelate with later experience and help make it meaningful.

Differences in early environment can also affect perceptual ability in human beings, as shown by a comparison of Zulus reared in two settings. The "trapezoidal illusion" is an illusion caused by rotating a trapezoidal window frame. The subject tends to perceive the longer end as always closer to him; the window appears to oscillate or sway rather than to rotate. Most Americans are subject to this illusion.

A group of urban Zulus and a group of herd boys—youngsters aged ten to fourteen who had not been off the native reserves—were tested for the illusion under four conditions. In this situation of ambiguous cues, 60 per cent of the urban group were subject to the illusion under all four conditions, but only 15 per cent of the rural group. In the rural Zulu environment, huts and enclosures are round, and the straight lines and corners common in an urban environment are virtually nonexistent (Allport and Pettigrew, 1957).

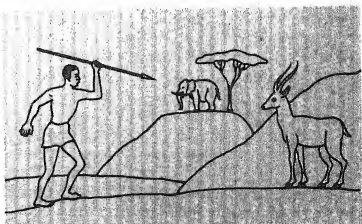
Pictorial depth perception is also affected by experience, as has been shown by tests using pictures similar to the illustration shown.

Africans belonging to illiterate and isolated subcultures characteristically failed completely to perceive the depth cues in such a picture despite their familiarity with such

cues in actual hunting situations. For example, they saw the elephant as closer to the hunter than the buck and usually thought that the hunter was attempting to spear the elephant instead of the buck. On the other hand, 50 per cent of a group of Africans of primitive background who were attending school at the time the tests were given and therefore had had experience interpreting pictures in books saw the relationships correctly or nearly so (Hudson, 1960).

Organic condition. The importance of the individual's organic needs as a factor in perception has been demonstrated clearly in experiments with hunger. As we shall see in Chapter 11, pictures of food flashed on a screen for very short intervals are recognized more readily when subjects are hungry than when they are not hungry. In another experiment on hunger and perception, performed with Navy personnel, it was found that hunger had the effect of increasing the apparent size of food objects perceived in ambiguous stimulus situations (McClelland and Atkinson, 1948).

Personal needs and values. A number of experiments have shown a relationship between the individual's needs and values and his perception of the people and objects in his environment. Interestingly, the serious research into this relationship began with a study that had a serious methodological flaw.



● Unschool subjects saw the hunter as trying to spear the elephant; educated ones saw him as trying to spear the buck.

A group of thirty ten-year-olds were tested with an apparatus consisting of a wooden box with a screen at one end and a knob at the lower right-hand corner. By turning the knob the children could vary the diameter of the circle of light shining on the screen. Two groups of children, one rich and the other poor, were asked to match the size of the circle of light to the size of coins of various denominations; a control group matched the light to the size of cardboard discs. The coins, socially valued objects, were judged larger in size than the discs. Furthermore, the poor group overestimated the size of the coins to a much greater extent than did the rich group (Bruner and Goodman, 1947).

This study led to considerable controversy because critics were quick to point out that there was no proof that values and needs were the determining factors, since other variables such as different intelligence and past experiences were not controlled. However, one group of investigators appears to have overcome these objections by the use of hypnosis.

Before being hypnotized, subjects adjusted the size of the light spot until it looked equal to the actual size of each of three coins—a nickel, a dime, and a quarter. When made to forget their real life histories and given "poor" life histories under hypnosis, the same individuals made settings consistently larger than the ones they had made in the normal state. When given "rich" life histories while hypnotized, they made consistently smaller settings than previously. Thus the conclusion was that their perceptions were indeed affected by needs and values. The effectiveness of the "poor" and "rich" life histories in inducing different needs and values was further shown by the fact that when "poor" the subjects sat erect and worked with great care, whereas when "rich" they slouched in their chairs, working rapidly and with a condescending attitude (Ashley, Harper, and Runyon, 1951).

Another personality factor that can affect perception is willingness to tolerate a relatively unstructured, ambiguous situation in the environment. Some individuals seem to feel a greater need than others to know at all times exactly "where they stand" with regard to their environment—physical or social. If they find themselves in an ambiguous situation they are more likely to "guess" at an interpretation than to tolerate uncertainty.

In a study concerning the relation of this trait to perception, male college students were given a vague task, such as sorting a pile of blocks of different colors and sizes any way they liked or describing themselves as they pleased. A record was kept of the number of questions they asked in an effort to define their tasks more clearly. The answers given them were very non-committal.

Later, the same subjects observed a card table through special lenses that made it appear to tilt. The lenses caused only enough distortion to exaggerate the normal conflict between immediate sensory impressions and the tendency to preserve a constant environment. When the subjects were asked to estimate the number of inches the table tilted, the ones who took longest to see the illusion and who then saw a smaller amount of tilt were the ones who had been least able to tolerate ambiguity in the first test (Martin, 1954).

It is scarcely surprising that the subjects who tended to suppress their immediate sensations in order to maintain perceptual constancy were the same ones who had tried to reduce the ambiguity of a vague interpersonal situation. Both types of behavior are directed toward preserving a well-structured environment—a form of homeostasis.

Several other studies have highlighted the relationships between perception, on the one hand, and individual needs and values on the other. One demonstrated the effect of failure on perception of ambiguous stimuli.

The subjects (college students) were divided into three groups and given a test. The members of one group were led to believe that their performance on the test had been very outstanding, whereas those in a second group were led to believe that they had failed badly. A third group acted as controls. All subjects were then shown, in very poor illumination, a series of slides which actually contained only a few dim smudges. As each slide was projected, the subjects were told in a general way what it represented and then asked a question about it:

Three men. What vocations do they represent?

Some books and some dishes on a table. Which are there more of?

The scoreboard at a ball game. Give the score for the home team and for the visitors. Note which is the home team's score.

The amount of a paycheck. What is the amount?

The responses of the "success" group and the "failure" group were then compared with the responses of the control group. The clearest results were obtained in the case of the slide which was accompanied by the verbal suggestion of a paycheck. The earlier report of failure increased significantly the amount of money seen on the paycheck. Of the "failure" group, 70.4 per cent saw the check as being greater than \$100; of the control group, 40.4 per cent; and of the "success" group, 34.5 per cent (McClelland, Atkinson, and Clark, 1949).

In our society, money seems to many people the common denominator of success, or at least an important and recognizable attribute of the successful person. It is not surprising, therefore, that the "failure" subjects—who presumably felt the greatest need for success—tended to exaggerate the value of the "paycheck."

Although values and needs undoubtedly influence everyday perception, further research is needed to determine just how much and in what ways, and the extent to which individual differences play a part (McCurdy, 1956).

Social Factors

We are social creatures and many of our perceptions are directly or indirectly shaped by our social experience.

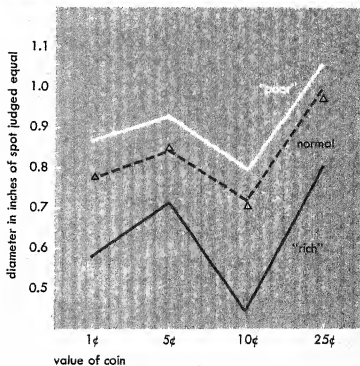
Cultural opportunities and limitations. Cultural influences play a vital part in perception. Much of the influence of culture derives from its importance in determining the direction of attention. For example, members of primitive tribes often develop powers of observing distant wild life that few of us could equal.

One early study showed that whereas American children learn early to discriminate many shades of color, members of the Chukchee tribe living in Siberia failed miserably on color-matching tests. On the other hand, the Chukchee subjects discriminated over two dozen different patterns of reindeer hides, many of which would look identical to us (Bogoraz, 1909).

We have seen that certain illusions may be perceived differently by primitive and civilized peoples. Evidently culturally determined experiences affect certain specific perceptions direct-

NEEDS AND VALUES INFLUENCE PERCEPTION

This figure shows the sizes of white spots judged to be equal in size to the four coins at the start of the experiment in the normal state and under "poor" and "rich" conditions when hypnotized. Triangles indicate the actual sizes of the coins.



Based on Ashley et al., 1951

ly and also exert a more general, indirect influence on perception through the shaping of personal needs and motives.

Social taboos. Cultural influences on perception are clearly demonstrated in our reactions to social taboos. Experiments have shown that we perceive words connected with cultural taboos much less readily than neutral or pleasant words. This phenomenon of *perceptual defense* has been studied with the tachistoscope, an apparatus which projects images or words onto a screen for a fraction of a second.

In one such study, college students were shown a list of eleven neutral words and seven taboo words, including terms like "belly," "raped," and "bitch." Thresholds of recognition were higher for the taboo words. To test the hypothesis that taboo stimuli arouse unconscious reactions before being perceived consciously,

ly, the investigator measured galvanic skin responses (see p. 424) of subjects prior to their recognition of the various words. The GSR was higher in the case of the taboo words, indicating the presence of greater emotion (McGinnies, 1949).

This work has been criticized on the basis that the "taboo" words are used less frequently in the English language than the "neutral" ones and hence might be more difficult to perceive simply because they were less familiar. To answer this criticism another experiment was carried out.

Twenty firemen and seventeen male schizophrenics were asked to recognize a list of taboo and neutral words. In this list the neutral words were ones which occur in the language with the same frequency as the taboo words. Again the thresholds of recognition were significantly higher for the taboo words. This was true for both normal and schizophrenic men. The latter showed higher thresholds for all words than did the normal men (McGinnies and Adornetto, 1952).

The work of McGinnies has also been criticized on the basis that the experimental design used permitted the subjects the opportunity of withholding their reporting of taboo words after they had perceived them and reacted emotionally to them, as measured by the galvanic skin reflex. A third study of perceptual defense was therefore made in the effort to show that a real lag in perception was occurring rather than merely a reluctance to verbalize the word after it had been perceived.

In this experiment the words again were selected according to frequency, but this time they were presented in pairs. That is, a "pre-task" word, sometimes taboo and sometimes neutral, was first presented for an interval of two seconds. Then the "task" word, always a neutral word, was presented for .01 second. If it was not recognized, the pre-task word was again exposed for two seconds, followed by the task word for .02 seconds. This was done until the task word was finally recognized. When the pre-task word was a taboo word, the threshold for recognition of the neutral task word associated with it tended to be higher than when the pre-task word was neutral (McGinnies and Sherman, 1952).

Since there would be no reluctance to speak the neutral task words, these findings seem to indicate that there was genuine perceptual defense, or interference, against the taboo pre-task words which spread to the task words that followed. These successive studies are a good example of how continuing research can plug loopholes in earlier studies and provide increasingly precise and unambiguous results.

Social suggestion. A more specific cultural factor is the influence of social suggestion upon our perception of various objects. We have already seen (page 298) how readily social suggestion can influence the direction of our attention, at least momentarily. In a similar fashion, we tend to perceive an object the way those around us seem to be perceiving it.

A well-known experiment has shown the influence of social suggestion on the perception of movement.

This experiment made use of the illusion of "autokinetic movement." The subjects were brought into a dark room and told to look at a small spot of light. Although the spot was stationary, it appeared to move. The reported extent of the autokinetic effect was studied for subjects tested singly and in groups. In the individual tests, the estimate of movement showed wide variation from subject to subject. When the subjects were tested in groups of two or three, however, and heard each other's estimates, the data from each individual tended to approach the average of his group (Sherif, 1935).

More recent experiments have corroborated the finding that social pressure often influences perceptual organization. Some of these will be discussed in Chapter 15.

People with a product to sell make use of the fact that we tend to perceive what we expect to perceive. Thus advertisers try to build up an expectation of desirable qualities in their products. Some of the best illustrations of this are found in the field of cigarette advertising. Cigarette manufacturers make distinctive claims for the taste, aroma, and soothing qualities of their particular brand, and habitual smokers profess to have deep-seated preferences for one kind of cigarette over another. Yet "blindfold tests" (conducted by psychologists rather than by manufacturers) have shown that relatively few

smokers can accurately identify different brands when they cannot see the label (Husband and Godfrey, 1934). The same thing is apparently true of different brands of cola (Pronko and Herman, 1950).

Accuracy of Perception

Our adjustment to external conditions can be adequate only if our perceptions are accurate and prompt. A distorted or incomplete picture will be of little use to us.

Unfortunately, there is no direct method for determining whether a person's perception has been accurate and complete. We can only infer the accuracy of his perception from the way he reacts to what he has perceived—verbally, with other actions, or both.

A group of law students sat listening to the opening remarks of a lecture on legal evidence by Erle Stanley Gardner, lawyer and famous mystery writer. Suddenly a woman burst into the room and rushed at Gardner, shouting, "You got my brother hung!" When she began to attack him with a pointed can opener, she was escorted from the room by the regular instructor, who then explained that the scene was a planned stunt to test the students' powers of observation. He asked the thirty-four members of the class to describe in detail the woman's clothing and appearance. Typical of the wide variation in replies were the answers to a question about her complexion. Three students said she was dark; two, ruddy; one, medium; five, fair; seven, pale; three, heavily powdered and rouged; thirteen said they did not know. Actually, the woman had a fair complexion, was freckled, and wore no makeup. Perhaps the most conspicuous item of her clothing was an old-fashioned shoe on her right foot—it was high-laced and had a pointed toe and high heel. It gave her a noticeable limp, since she was wearing a low-heeled shoe on her other foot. Yet twenty-five of the thirty-four students failed to mention either the outlandish shoe or the limp (*Science News Letter*, 1954).

How do so many serious errors creep into our descriptions? Numerous factors may be responsible. Sometimes a defect in the witness' sensory equipment, such as near-sightedness, will cause errors. Or sensory data may be interpreted wrongly. If the report is not made soon after the event is observed, faulty memory may play

a part in causing errors. But the greatest cause by far is *poor attention*.

Usually perception is much less complete and much less accurate than the stimuli of a given situation would make possible. We tend to see what we expect to see. And in unusual situations, such as an accident or a scene like that described above, we often are distracted by the general excitement and do not think about paying attention to details. Luckily, accuracy of observation can be improved greatly by training. Policemen are decidedly superior to the average person in ability to observe details because they know what to look for and because they practice extensively. There is often good reason for the judge to give more weight to the testimony of the policeman when his report differs from that of the defendant.

Interaction of the Senses

The main thing that an individual is doing at any one time is constantly being influenced by simultaneous activities. Usually we are organizing data from several sensory modes at once—visual, auditory, kinesthetic, and perhaps olfactory. That the contribution of one sense is modified by that of another has been demonstrated in several studies.

In a study showing the influence of auditory stimulation on the perception of verticality, college students were asked to look at a 40-inch luminescent rod in a dark room. The rod was pivoted at its center and could be rotated. The subjects wore headphones which permitted the presentation of auditory stimuli to either ear or both. Their feet did not touch the floor but were placed on a foot rest, in order to reduce cues for orientation in space. Three different intensity levels of stimulation and five different starting positions of the rod were used. On each test, the subject told the experimenter how to move the rod in order to make it seem vertical. The subjects had their eyes covered with goggles between tests.

It was found that the position of apparent verticality of the rod was shifted away from the side being stimulated with sound when only one ear was stimulated and away from the side of more intense stimulation when both sides were stimulated. The amount of shift was related directly to the intensity of the auditory stimulus. When different sounds were conveyed to the two ears,

no shift in apparent verticality occurred (Chandler, 1961).

The reality of sensory interaction and its importance in perception were both demonstrated in an ingenious early experiment.

Subjects were shown two color wheels in bright daylight, one red and one blue, and asked to change the proportions until the colors looked equally bright. According to the Purkinje effect (p. 261), lowering the illumination after this would have made the blue seem brighter so that the red one would have had to be made more intense to equal it. Instead of lowering the illumination, however, the experimenter introduced a "dark" chord—a D minor one. The adjustment followed the Purkinje effect: more intensity was added to the red. A "dark" sound had had the same effect on visual perception as a reduction of light would have had (Börnstein, 1936).

Other studies have shown that tensing one's muscles influences perception of color and, conversely, that changing the color of lighting influences muscle tension (Goldstein, 1939).

The timing of stimulation of points on the surface of the body can influence the perceived distance between them. This is called the *tau* effect. Three points on the forearm, equally spaced, are stimulated by rods. If the time between the first and second stimulus is shorter than that between the second and third stimu-

lus, the subject perceives the first two points of stimulation as closer together spatially than the second and third (Helson & King, 1931). The same phenomenon has been observed in vision and hearing and persists even when the subjects know that stimuli are equidistant.

It has been argued that initially the infant or young animal does not distinguish between specific sights, sounds, and tactual sensations but only between such general dimensions of experience as light or dark, bright or dull. Even for many adults, there seem to be "light" and "dark" sounds and smells, and many people tend to "see" certain colors when they hear sounds. This is known as *synesthesia*.

Visual imagery in response to auditory stimuli is the most common example of synesthesia. In such cases there are no absolutely fixed relationships between the visual images and the nature of the auditory stimuli, but the following tendencies have been observed: (1) a rise in pitch or a quickened tempo usually brings increased brightness of the image; (2) smooth music brings visual images with graceful, flowing lines; syncopated music is associated with jagged lines; (3) different instruments give rise to images of different colored lines; and (4) increases of volume make the images larger. About 10 per cent of the adult population enjoys such "colored hearing" when listening to music or other sounds. Some people have colored images even when recalling music (Karwowski and Odbert, 1938).

THE PERCEPTION OF SPACE

One of the most important adjustments we make to our physical environment is perceiving the size, location, and physical qualities of objects in three-dimensional space. When we look at a parked automobile, we perceive it as a three-dimensional object of a specific size and

shape located in a specific place. If the automobile is moving, we judge its speed in terms of its changing relationship to other objects in space. If we hear only the sound of its horn, we use perceptual cues to judge the distance and direction from which the automobile is coming.

Visual Perception of Stationary Objects

How can the human retina—a curved two-dimensional surface—enable us to perceive a world of three dimensions? The manner in which this occurs is as complicated as it is wonderful.

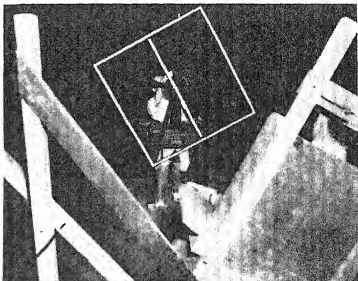
Monocular perception of depth. Although binocular (two-eyed) vision is necessary if we are to receive the greatest number of possible cues about depth, we have several cues even with monocular (single-eyed) vision. In addition to those arising from the stimulus pattern itself, which we will discuss shortly, we get cues from the stimulation of muscles in and around the eye.

The muscles responsible for the various eye movements possess sensory receptors which are stimulated when the muscles contract. For every motion of the eye there is a corresponding pattern of stimuli from the muscles which tells us how far the eye has moved and where it is at a given moment. For example, the lens of the eye bulges out when we look at close objects and flattens when we look into the distance. Each degree of bulge in the lens gives rise to a characteristic pattern of stimulation and thus provides cues by which we perceive the distance and depth of the object being seen. Additional cues are derived from the stimulation of the muscles involved in turning the head to look at an object.

Binocular perception of depth. The superiority of normal binocular vision is based on the depth cues provided by the convergence of the eyes and the difference in retinal images.

Convergence. Normally the two eyes converge in looking at a single point or small area. To illustrate convergence, hold the tip of one finger as far away from you as you can and look at it with both eyes open. Then bring it closer and closer to your eyes until it fairly touches your nose. Observe how the sensation of muscular strain in the eyes increases as the finger comes closer. This cue is not available to the one-eyed person in the same degree, as you can readily see if you repeat the above experiment with one eye closed. When looking at objects thirty feet or more away, the two eyes become

◆ Pictured here is another form of apparatus frequently used in studies of space orientation. In this case, both the subject in his chair (foreground) and the stimulus object can be tilted at will by the examiner (Witkin *et al.*, 1954).

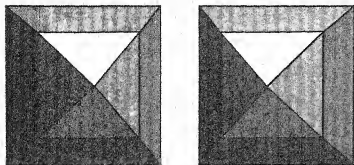


practically parallel, and beyond this point convergence has little value as a basis for depth perception.

Differences in retinal images. Differences between the images which the two eyes receive of the same object also help us to perceive depth and distance. Cover your left eye and study carefully some solid object close by. Now, without changing the position of your head or eyes, cover your right eye instead. Notice the difference in the retinal picture. With the right eye you see more of the right side of the object; with the left eye, more of the left side. This is referred to as *retinal disparity*. We interpret distance by automatically comparing the two slightly different retinal images.

Stereoscopic color slides are an application of this principle. Two pictures are taken simultaneously by a camera with two lenses positioned a slight distance from each other. When the two pictures are viewed, one by each eye, the effect is that of a single, three-dimensional picture. By increasing the distance between the two pictures, it is possible to increase the illusion of depth up to a certain point. When the two views become too different, however, they no longer merge in perception but are seen alternately.

The stereoscopic principle is used in the study of aerial pictures taken from different points in flight. Look at the diagrams below.



They show the top of a monument as it might look from two positions. Take a piece of cardboard ten to fourteen inches long and place it vertically between the two figures. Next, hold your head in contact with the upper edge of the cardboard so that the left eye sees only the diagram on the left and the right eye sees only the diagram on the right. The two flat images will fuse into a solid which appears to be located at a position between the two drawings.

Cues from the stimulus pattern. Whether our vision is monocular or binocular, we receive several additional cues about depth and distance from the stimulus pattern itself. Among these are cues based on distinctness, linear perspective, texture, light and shadow, relative position, and known standards. All contribute to the fund of data which perception organizes into a meaningful whole.

Atmospheric perspective. Because of dust and smoke in the air, objects a long way off may appear to be blurred and indistinct in outline. Details we know are there may not be observable. The extent of the dimming depends on the distance, and we learn to interpret distance in these terms. In fact, when the characteristic condition of the air changes, we often judge distances incorrectly. For example, a person reared in a smoky industrial city will greatly underestimate the distance of objects seen through clear mountain air. A tenderfoot on a ranch will amuse the old hands by announcing that he is going to ride to a certain hill and back before breakfast, only to learn that the "hill" is really a mountain some forty miles distant.

Linear perspective. Objects appear smaller and closer together as they become more dis-

tant. Railroad tracks or the edges of a highway appear to meet on the horizon. Uniformly spaced objects such as telephone poles appear to be spaced more closely as they recede into the distance. These phenomena of linear perspective are used by artists to represent distance in pictures.

Texture. Closely related to linear perspective is the factor of texture. On any surface not perpendicular to the line of sight, the texture elements appear denser as the surface recedes. Thus texture is an adjunct to linear perspective, operating in situations where there are no converging parallel lines.

Light and shadow. When light strikes an irregular surface, as for example the human face, certain parts are brightly illuminated and others are cast in shadow. The appearance of these shadows tells us much about the depth of the parts concerned. ■ The artist uses shading and highlights to convey the notion of depth on a two-dimensional canvas.

Relative position. When two objects are in the same line of vision, the nearer one conceals



■ Look at this photograph of Mars sent by telemetry from a camera on a rocket. Do you see craters? If you turn the book upside down, what do you see?

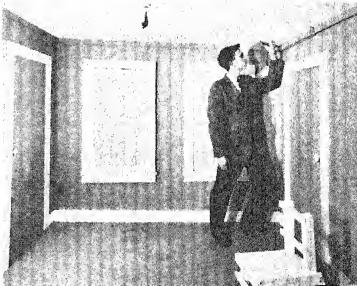
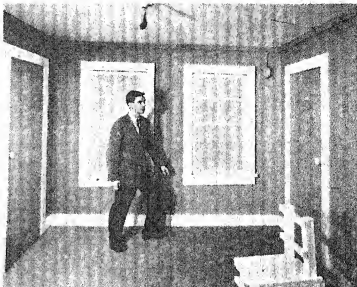
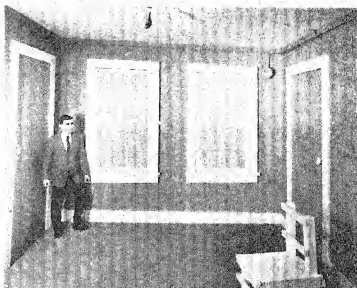
all or part of the farther one. Near objects usually appear at the bottom of the two-dimensional field of vision, distant objects at the top.

Known standards. Once we are familiar with the height of a particular man, we see him as that tall regardless of whether we are looking at him from a distance of a few feet or a hundred yards. This phenomenon is known as *size constancy* and can be easily illustrated. Hold a fifty-cent piece (or any other familiar object) close to your eyes and note its size. Now move it away (thus providing a smaller retinal image). Does it seem smaller? Probably not, unless you have moved it far beyond your arm's length. Dependence upon known standards can sometimes lead us to see strange things, however, as in these photographs. • Interpretation of size in terms of known standards has become automatic in the adult, but it is often lacking in the child. A small child often will think that a man seen in the distance is a boy.

If you do not know the true distance of a familiar object and the size of the retinal image representing it is made small through the use of lenses, you see the object as far away; if the retinal picture is made large, you see the object as close to you. The converse of this can also be illustrated very simply. Gaze intently at a colored square of paper. After about a minute, project the after-sensation onto a plain wall several feet away. The image will now seem larger. The size of the retinal image does not change as you alter the distance at which your gaze is directed, but its perceived size changes through your interpretation of it.

Experiments with Visual Distortion

One of the classic experiments in perception was that in which a psychologist wore a specially designed pair of goggles which inverted the retinal image (Stratton, 1897). At first the world looked upside down, but after a number of days objects began to right themselves and eventually the world came to look absolutely normal. When he stopped wearing the goggles, the world again looked upside down but returned to normal in a few days.



• Look at this man as he walks across the room. He grows larger with every step he takes. Or does he? What standards are you using as cues to his height? To see whether those standards are accurate, turn to page 318.

In the last sixty years similar experiments have given us much useful knowledge about our eyes and how well they perform despite obvious structural defects in them (Kohler, 1962). As any student of general science should remember, strong lenses distort forms and colors. But the modern ophthalmologist need have no fear in prescribing them, for he now knows that the unpleasant effects will soon disappear and can so assure his patient.

The operation to repair a detached retina is a delicate one that sometimes leaves a small fold in the reattached retina, resulting in a large bulge in the patient's visual field. Here again the physician can assure his patient that although the fold will never go away, the bulge in the visual field will eventually disappear.

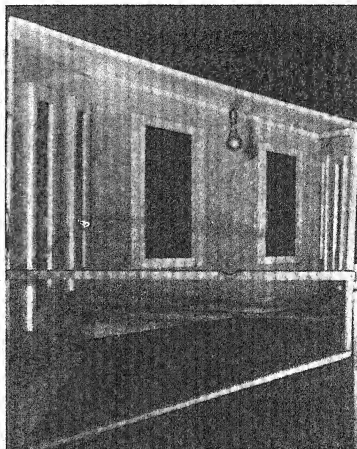
Experiments with "squint glasses" composed of prisms have also produced some very interesting results. * One subject who had been wearing squint glasses for less than a day reported as follows:

"In the course of a trip through town, I made the following peculiar observations: multicolored posters, traffic signs, people wearing multicolored clothes, and so on, did not as before appear to lie in one plane, but blue seemed to protrude far beyond the object plane, whereas red seemed to recede, depending on whether the background was bright or dark. A woman carrying a red bag slung over her back seemed to be transparent, and the bag to be inside her, somewhere near her stomach. . . . Most peculiar was a woman wearing a red blouse. She had no upper body, and the red blouse seemed to be following her about a pace behind, moving its empty sleeves in rhythm with the movement of her arms." (Kohler, 1962, p. 69)

There was no adaptation to this color-stereo effect even in the case of a subject who wore the squint glasses for fifty-two days.

The relationship of the color-stereo effect to the eye's ability to see color is not yet understood. A man who had lost his color vision as the result of an injury reported that when he put on squint glasses he could see all the colors to which he had been blind for years. When he removed the glasses, the colors disappeared. This puzzling case has stimulated intensive investigation.

This is a room similar to the one shown in the photographs on page 317. Although you can readily see the distortion in this view of it, if you were to rest your chin in the hollow in the crossbar and close one eye, you would see it as the camera saw the other room.



Visual Perception of Motion

Movement is simply the progressive change of an object's position in space with time. It is not necessary for the object to be perceived in all of the intermediate positions in order for it to be seen as moving. In fact, the eyes never follow a moving object with sufficient precision to keep it in full view at all times. Here again, perception is a process that fills in the blanks.

Relative motion. When you look from a rapidly moving automobile, near objects seem to pass by more rapidly than those at a moderate distance, while those very far away may actually seem to be going in the same direction you are. Hold a finger at a distance of one or two feet away from you and look at it intently. Then, without changing your fixation, move your

head. Which way do objects beyond your finger seem to move? Now look at the distant wall and move your head. Which way does your finger seem to move?

Relative motion is also interpreted in terms of known standards based on experience. When you travel in a train or automobile, you can judge your speed fairly accurately by looking out the window and noticing how rapidly nearby objects are passing by. You can make this estimate because of past experience in similar situations.

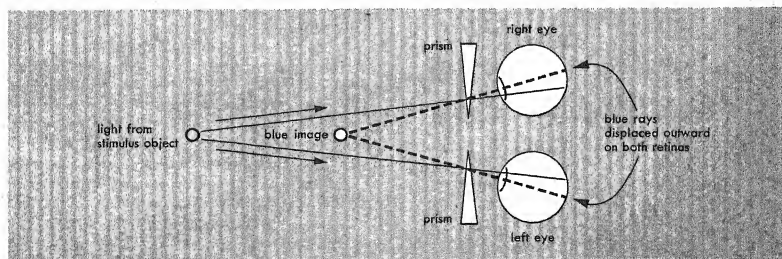
On their first airplane flight, many people underestimate the speed of the plane because the ground below seems to move so slowly. At 75 miles per hour on a train, the ground outside fairly streaks by. But at 600 miles per hour at an altitude of 48,000 feet, the ground below seems almost motionless. With more experience, the air traveler develops new standards by which to interpret these visual cues and so can judge the speed of his plane much more accurately.

Radial motion. Radial motion is movement directly toward or away from the observer. Continuous radial motion is perceived when the size of the retinal image continuously changes.

In a study confirming this generalization, observers viewed a diamond-shaped spot of light which actually moved back and forth and also a stationary light which was systematically varied in size. Both spots appeared to move. When viewed with only one eye, the spots appeared to move about the same distance. When viewed binocularly, however, the spot of light which really was in motion appeared to move farther than did the stationary light. When observing the stationary light alone in a well-defined field, the subjects found it difficult to decide whether it really was moving or not (Ittelson, 1951).

This experiment also confirmed the fact that the perception of radial motion depends partly upon the individual's assumptions regarding the true size of the observed objects and the constancy of their size. The changing size of the retinal image, interpreted in the light of these assumptions, gives him his perception of motion.

Why motion pictures move. The so-called motion picture is simply a series of still pictures taken one after the other at a rate of fifteen to twenty-five per second and flashed on a screen at the same rate. How is it that this series of separate still pictures is seen as the same object



▲ Squint glasses produce the effect diagramed here: the blue rays are bent most by the prisms; thus they stimulate points on the retina farther to the sides than the other wave lengths and give rise to sensation of blue located in the part of the visual field usually associated with such stimulation. If only the right eye were involved, the blue would be displaced to the left. With both eyes stimulated, there is a stereoscopic effect, with the blue seen as nearer and red seen as farther away than the object itself.

or objects in smooth, continuous motion? Why do the movies not "jump"?

In the motion picture, as in life, objects are seen in successive positions in space. When the gaps between are not too great and when the successive positions are perceived rapidly enough, the perception of continuous movement takes place. The motion picture, in other words, is merely a practical application of a fundamental fact about visual perception of motion.

The motion-picture camera can be used to "speed up" or "slow down" some action so that it can be studied more easily. If fewer than twenty-five pictures per second are taken and then shown at the standard speed, the action progresses much more rapidly than it would in real life. In this way, a flower appears to burst into bloom in a few seconds. Rapid action, on the other hand, can be "slowed down" by taking more than twenty-five pictures per second and showing them at the standard rate. Slow-motion pictures are used by athletic coaches to observe and point out to players the good and bad points in their performances and by industrial efficiency experts to study the least time-consuming motions for performing a standard factory task.

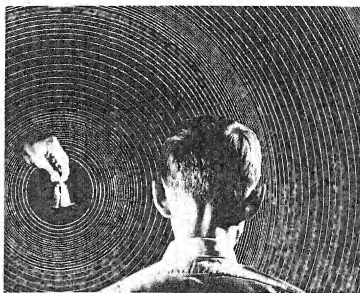
Recent developments in cameras and film have made it possible to "slow down" or "stop" bullets and projectiles of high velocity so that the exact manner in which they penetrate solid substances may be determined. Many things happen too fast for us to perceive under normal circumstances.

Locating Stationary Sounds in Space

People are able to locate the position of sounding objects in space in terms of distance and direction. This ability to locate sounds is of considerable adaptive value in modern life. For example, in crossing a busy street your very life may depend upon your knowing accurately the position from which an unseen automobile is bearing down on you.

Perceiving the direction of sounds. Our ability to localize sounds is due almost entirely to our possession of two ears located at different

■ In the ear closer to the bell, the sound wave arrives first, is stronger, and is in a different phase from the wave arriving at the other ear. The individual uses these cues to determine the direction from which the sound is coming. Sounds on the midline however—in front, above, or behind—he cannot localize.



points in space. The diagram illustrates the fact that a given sound wave stimulates the two ears differently in three distinct ways. ■

1. A sound coming from an object at the left of the head strikes the left ear before the right one. This difference in time can be very short, but it tells us from which side the sound is coming.

2. Sound waves coming from the left stimulate the left ear more strongly than they do the right ear.

3. Sound waves, as we saw in Chapter 8, consist of areas of high and low pressure. Since the two ears are at different points in space, a sound wave will be in different phases as it stimulates the two ears. Sound waves travel very slowly as compared with light waves, with the result that differences in phase in sound waves are appreciable.

We can use these cues to direction only when sounds come from one side or the other. Sounds directly in front of us cannot easily be distinguished from those above or behind us because the stimulation reaching the two ears is identical.

Certain subjects have reported a very interesting experience when their two ears are *simul-*

taneously stimulated by clicks in each of two headphones. When the click in the right headphone is louder than the other, it is heard as one click coming from the right. Conversely, if the left ear gets the louder of the two clicks, the subject hears the sound as coming from the left. If the sounds are of equal intensity, however, the sound is heard as coming from *inside* the head at a point equidistant between the two ears.

In certain experiments with this phenomenon, one ear has been adapted to sound by continuous stimulation at a fixed intensity. This is done after the subject has first achieved his individual balance by adjusting the sound apparatus so that the intensity of sound reaching each ear seems equal. That is, the sound appears to be coming from the middle of his head. When a sound of low intensity is presented to an ear that has been adapted for ten minutes at 60 decibels or higher, the sound image is heard at or toward the unstimulated ear. Thus through monotonic stimulation alone a sound image can be made to seem located anywhere in audito-

ry space, even at the opposite ear (Carterette, Friedman, Lindner, and Pierce, 1965).

This experiment, like those with the visual cliff, is hard to explain on the basis of prior learning. Very few of us have heard real clicks from inside our head.

Perceiving the distance of sounds. Two clues help us to determine how far away the source of a familiar sound is—*loudness* and *timbre*.

The farther away its source, the weaker the sound will be. The ear-splitting locomotive whistle heard in the station becomes fainter and fainter as the train moves away.

The farther away a sound is, the purer it will be. The tinny jangle of a cheap phonograph gives way to mellow music when heard in the distance, as from across a lake. This increase in purity results from the loss of the irregular sound waves (or noise) and from the loss of certain shrill overtones, which lack sufficient energy to carry very far.

THE PERCEPTION OF TIME

"The mind of man works with strangeness upon the body of time," wrote Virginia Woolf in *Orlando*. "An hour, once it lodges in the queer element of the human spirit, may be stretched to fifty or a hundred times its clock length; on the other hand, an hour may be accurately represented by the timepiece of the mind by one second." (Woolf, 1928)

Although most people today are slaves to the dictates of accurate clocks which measure fixed intervals of time, every person perceives those intervals somewhat differently. The same lecture period that speeds by for the student who is engrossed in his favorite subject will drag for the one who wants to get out of class and go to football practice or the one who sees through the window his best girl flirting with his rival.

Many factors can come to influence our perception of time. Among these are a sense of the sequence of events, a memory of the past, a feeling of how long it has been since a certain event occurred, and an orientation toward the future. Among many primitive tribes time is measured in terms of social events or tasks rather than units of duration. Not surprisingly, in such societies time perception is less differentiated than in our own. For example, the Trobriand Islanders near New Guinea have neither past nor future tenses in their verbs. All events, real and mythical, are regarded as taking place in a sort of universal present (Lee, 1949). In a culture such as ours, however, a loss of the sense of the past is tantamount to a loss of personal identity.

Estimating Intervals of Time

When you go to bed, can you "set" yourself to wake at any designated hour, regardless of how tired you are or how soon that hour is to arrive? Some people can do this so accurately that they do not need an alarm clock. The reason is that most physiological processes are correlated with time. Many internal changes reveal the passage of long intervals of time, whether we are awake or asleep. There is a distinct rhythm in our periods of hunger. The tension on the bladder increases with the passing of time until it is relieved. As time passes in waking activity, we become more and more tired. The "time to go home" usually becomes apparent to us without our having to look at a clock. In judging periods of an hour or more, we also depend upon such cues as how much has happened or how much we have accomplished.

Certain other creatures seem to be superior to man in their ability to judge periods of time—bees, for example, have been trained to come to a particular place for sugar every three hours, or even every six hours, with only a few minutes' error (Cohen, 1954).

Many lines of evidence suggest that the perceived length of short intervals of time is some-

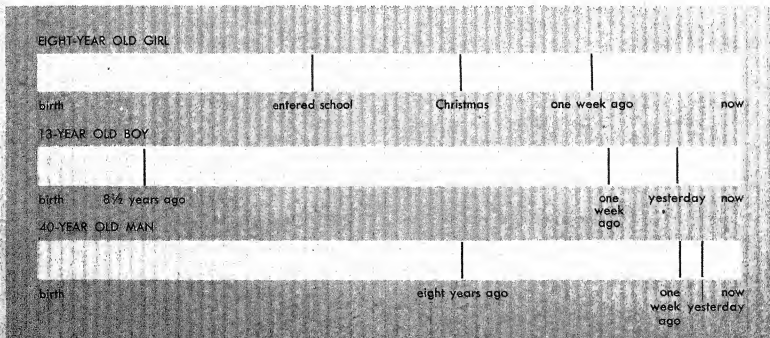
how related to the speed with which vital activities go on in our tissues.

Body temperature plays a part in regulating our sense of time. One investigator became aware of this during the illness of his wife. When her temperature had risen to 104 degrees, she asked him to go to the drugstore for medicine. He was gone only about twenty minutes, but she insisted that he was away much longer. Suspecting that her high fever was affecting her sense of time, he carried out a series of bedside counting tests which showed that fewer than sixty clock seconds passed during what seemed like a full minute to her. The number of actual seconds per subjective minute varied with her body temperature: the higher her temperature, the shorter the time she estimated to be a minute (Hoagland, 1933).

A high body temperature is an indication that vital activities are being carried on at greater speed than normal, and evidently the sense of time is affected by this general acceleration.

It has been found that people's auditory discrimination of time is finer than their visual discrimination. The average person can perceive two sounds as successive rather than as continuous if they are separated by only 2 *milliseconds* (thousandths of a second); two visual experi-

▲ TIME PERSPECTIVE AND AGE



ences, on the other hand, must be 50 milliseconds apart. If one experience is visual and the other auditory, 80 milliseconds must elapse between them or they will seem simultaneous (Cohen, 1954).

Factors Affecting Perception of Time

Time, like space, is perceived differently according to a variety of conditions within the perceiver. The factors of age, intelligence, activity, and motivation have been studied in considerable detail.

Age and experience. In spite of wide individual differences in the speed with which specific time concepts are acquired, the ability to perceive time follows an orderly course of development. This was shown in a study dealing with children's knowledge of clock time.

The subjects in this study were eighty-nine children aged four to six who had been given no instruction in telling time at the nursery school where they were enrolled. In telling what time of day certain activities took place, the youngest ones tended to use descriptive terms such as "early" or to use a sequence of activities such as "after nap." The next stages were to give an unreasonable time, then a reasonable but incorrect time, and finally the correct hour. Thus when asked what time they left school, 41 per cent of the four-year-olds gave unreasonable times, whereas 74 per cent of the six-year-olds were able to name the correct hour.

Telling time by the clock preceded being able to set the clock and to understand why the clock has two hands. Whereas only 4 per cent of the four-year-olds were able to set the clock at 2:00 and 9:00, 45 per cent of the six-year-olds could set it at 2:00 and 35 per cent at 9:00.

Half and quarter hours were more difficult both to recognize and to set. One interesting error made by a few children at both age levels was to mistake 12:30 for 6:00. Their comments revealed that a favorite radio program came on at 6:00, and they had learned to watch for the hands to be "straight up and down" (Springer, 1952).

The apparent duration of weeks, months, and years varies with the age of the subject.

Subjects were asked to mark off on a ten-inch line representing the time from birth to "now" sections corresponding to how long it seemed since yesterday, a week ago, last Christmas, a year ago, and so on. The length marked off for one day ago was disproportionately long as compared with the length for a week or a month ago. For more recent events there appeared to be a logarithmic relation between the length of line marked and the interval it represents. However, for intervals greater than one year ago, this relation no longer held, and the length marked off for five years, for example, was about five times the length marked off for one year. The younger the subject, the greater the distance away one week ago seemed. To the eight-year-old girl, last Christmas was a third of the way back toward birth and starting school was over half of the total distance away (Cohen, 1964).

Motivation. Time spent in monotonous work is usually overestimated. Time spent in interesting work is usually underestimated.

In one experiment two subjects were engaged in the dull task of sorting balls. At various intervals each was asked to estimate the length of time already spent. The amount of error in the estimation was correlated with the degree of boredom reported by the subjects. The records of one subject follow (Wyatt, Fraser, and Stock, 1929).

Actual Time in Minutes	Estimation When Slightly Bored	Estimation When Greatly Bored
30	25	30
50	50	55
70	75	85
90	100	110
100	110	120

Judgment of time is related to feelings of success or failure. Subjects who are experiencing failure judge a given interval as longer than do subjects who are experiencing success (Hartson, 1939). A given interval of time is also estimated as longer by subjects trying to get through a task in order to reach a desired goal than by subjects working without such motivation, giving experimental confirmation of the adage that "a watched pot never boils" (Filer and Meals, 1949).

Drugs. There are a number of drugs that influence the apparent length of time. Among these are amphetamine and secobarbital (Goldstone, Boardman, and Lhamon, 1958). When an individual is under the influence of amphetamine, an interval shorter than a second is perceived as a second. Secobarbital has the opposite effect.

There is a fairly general belief among jazz musicians that marijuana improves the sense of time and rhythm. The experimental evidence does not support this point of view (Aldrich, 1944). It is quite possible, however, that marijuana, by making a physical unit of time seem longer, encourages the drummer or other musician to attempt a faster beat.

REACTION TIME

Action is the objective proof of observation. The interval elapsing between the presentation of a stimulus and the action that follows it is the individual's *reaction time*. The speed with which we act in response to a perceived situation depends upon many factors and has many implications for daily living.

Measuring Reaction Time

The apparatus for a typical reaction-time experiment consists of three parts: (1) a stimulus key which is pressed by the experimenter to stimulate the subject and at the same time start a clocklike mechanism; (2) a reaction key which the subject presses the moment he perceives the stimulation, stopping the timing mechanism instantly; and (3) a device to check the accuracy of the timing mechanism. •

The timing mechanism, or *chronoscope*, is frequently a type of electric clock with a frequency of pulsation controlled by a tuning fork. The accuracy of the clock is checked against the time required for a ball bearing to fall a certain distance.

In experiments using apparatus of this nature, reaction time is measured with a high degree of accuracy in milliseconds (thousandths of a second). This interval is also referred to as a *sigma* and is represented by the symbol σ . (This should not be confused with the use of the same symbol to represent a standard deviation.)

People differ greatly in their simple reaction times and even more in reactions where the element of choice or decision is involved. The average college student, for example, takes about .55 of a second to put on the brakes of his automobile when he sees a red light or other signal that he should stop as fast as possible. At sixty miles an hour his car will travel 48 feet *before* his brakes begin to take hold and about 200 feet more before the car comes to a stop. At the same speed, a person with a braking reaction time of one second will travel the length of a football field before stopping.

Studies have shown that the person with a fast reaction time is not as safe a driver as the one of average reaction time. Slower than average reaction times are also less safe than the average. In general, slow reactors hit the car ahead and fast reactors are hit in the rear when a line of traffic must stop.

Factors Influencing Our Speed of Reaction

Although the need for fast and accurate reaction time is rapidly being lessened by the use of electronic devices for sensing situations and controlling actions, there are still many situations where reaction time is involved and where knowledge concerning it is valuable. A number of generalizations concerning reaction time have been fairly well established (Teichner, 1954). Among the most important of these are the following:

1. When two sense organs are stimulated simultaneously, reaction time is faster than when only one is stimulated. On the other hand, consecutive stimulation of different sense organs produces slower reaction times than repeated stimulation of the same organ.

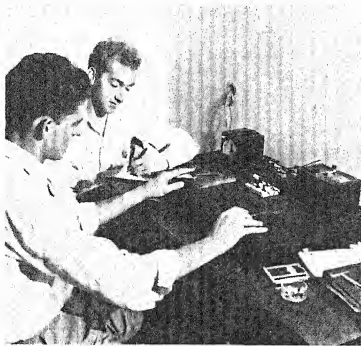
2. In the case of visual and thermal reaction times, the more space covered by the stimulus—that is, the greater the number of receptors stimulated—the faster the reaction time will be, up to a certain limit.

3. Under good illumination, visual reaction time becomes shorter as the distance of the stimulus from the eye decreases. (This is fortunate indeed for the automobile driver.)

4. Reaction time decreases with age until the individual is about thirty, after which it gradually increases.

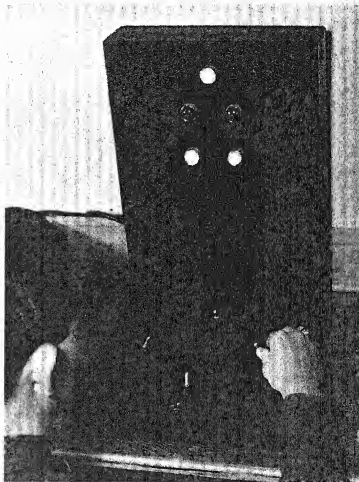
5. In general, men have faster reaction times than women.

Many specific factors influence speed of reaction in a given situation. Among these are the sense organs involved, the strength of the stimulus, the nature of the fore-period, the strength of motivation to respond, the amount of prac-



● With the classic apparatus used to study speed of reaction, the subject presses a key the instant he perceives the stimulation. Automatic timing devices clock both the stimulus and the subject's response, and the interval between them is his reaction time.

■ Reaction time is slower if the subject must react differently in response to different patterns of stimulation. Here the subject must push a different switch for each of four patterns.



tice in responding, and the complexity of the reaction. ■

The sense organs. Reaction to sound is faster than reaction to light. For example, reaction time in braking an automobile is shorter in response to a horn than to a red light (Elliott and Louttit, 1938). A study of factors influencing the reaction time of pilots reached a similar conclusion about the practical superiority of auditory over visual stimuli (Canfield, Comrey, and Wilson, 1949).

One possible explanation is that a visual stimulus does not stimulate a nerve ending directly. When light waves enter the eye they set up a chemical reaction which in turn stimulates the nerve endings. This chemical reaction takes a certain amount of time. In the case of

hearing, however, the stimulation is mechanical—the pressure-sensitive receptors are stimulated directly. Also there are fewer synapses involved. Studies of individual variations in reaction time indicate that there is a positive correlation between the auditory and visual reaction times of the same individual, even though the mechanisms are different.

Kinesthetic reaction time, as measured by a subject's speed of reaction to the sudden falling of his arm, is about the same as auditory and tactual reaction time when the response is pressing a key but is the shortest of the three when the response is stopping the arm movement. Surprisingly enough, reaction time to pain is the slowest of all.

Individual differences in experience may affect reaction time to different stimuli. One investigator who compared tactual, visual, and auditory reaction times found, for example, that tactual reaction time was shortest in trained subjects, with auditory and visual about equal. In untrained subjects, however, auditory reaction time was superior, with tactual about equal to visual (Lanier, 1934).

The strength of the stimulus. At levels close to the threshold, increasing the strength or duration of the stimulus will shorten the reaction time. For each individual, however, there is an optimal duration. This relationship holds for both normal children and retardates but is stronger in the case of the mentally retarded (Baumeister, Hawkins, and Kellas, 1965).

The nature of the fore-period. At a track meet, the starter prepares the competing runners by saying, "On your marks . . . set . . ." before firing the starting gun. Careful experiments have shown that reaction times are shorter when the subject is warned that the stimulus will be forthcoming. This enables him to build up a set toward action. Because so many factors are involved, such as the duration of the warning signal and the amount and location of muscular tension produced, no one length of fore-period can be considered best. In general, the optimal range is between approximately 1.5 and 8.0 seconds (Teichner, 1954). The experienced starter varies the period of warning somewhat, forcing the runners to respond to the

sound of the gun rather than to an earlier cue.

It used to be thought that a motor set was better than a stimulus set—that the runner should concentrate on the movements his body would have to make in getting off the starting blocks, while letting the hearing of the starter's shot "take care of itself." Careful research has shown this, to be wrong.

In experiments with forty men and forty women students, the investigator asked them to release their grip on a plastic strip and strike a tennis ball in response to a flash of light. He found that those who had a tendency to think of the light stimulus reacted faster than those who tended to think of the action to be performed. Furthermore, training the group that had the "motor set" to concentrate on the stimulus improved their performance (Henry, 1957).

Related to the above is the finding that groups who have formed a "set" to expect a particular event will make a stronger response than usual if an event other than the expected one occurs (Grings, 1960).

Motivation. Speed of reaction also seems to depend on motivation to respond.

In one experiment, speed of reaction to unpleasant auditory stimuli was measured. The subjects' reactions to a stimulus of 71 decibels intensity were faster when the response served to end the stimulus than when reaction time had no effect on the stimulus duration (Chernikoff, Gregg, and Brogden, 1950).

The results of this experiment may be accounted for, at least in part, in terms of motivation to escape a painful stimulus.

Practice. The time taken to react becomes shorter with practice, largely because the subject learns to ignore distractions and to pay closer attention to his task. However, the physiological limit of improvement under given conditions is soon reached. Variability of reaction time also decreases with practice.

The complexity of the stimulus. As might be expected, responses to the more complex stimuli usually encountered in everyday life require more time than the very simple reactions studied in the above experiments. It takes longer to

react when a complex meaning must be perceived.¹ For example, the average time required for pilots' eyes to move in pursuit of a suddenly appearing target is 200 milliseconds (Travis, 1936), whereas the time required by pilots to fixate individual instruments when making a blind landing is three times as great (Fitts, Jones, and Milton, 1950).

Similarity of stimuli. As two stimulus patterns become more alike, it takes increasingly longer to distinguish between them. Reaction time can thus be used as a criterion of difficulty in discriminating between two or more stimulus patterns. This principle finds practical application in the design of instrument panels—it is important that incoming signals be clearly distinguishable and control buttons or levers not easily confused.

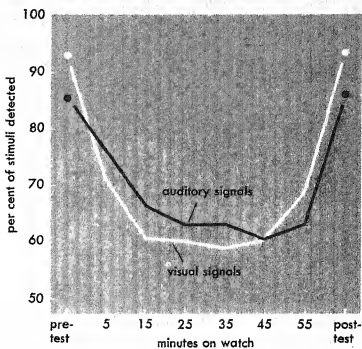
Other factors influencing reaction time. It is impossible to mention more than a few of the many other factors that have been studied in relation to reaction time. Consumption of alcohol lengthens both visual and auditory reaction time. There is evidence that some nutritional deficiencies may also slow down speed of reaction. When body temperature is high, reaction time is slightly shorter (Kleitman and Jackson, 1950).

Aircraft pilots, and particularly astronauts, are often subjected to a factor known as acceleration, or "g." Positive radial acceleration effects are produced when a plane or space ship changes direction suddenly—as in pulling out of a dive, banking sharply, starting to climb rapidly in an inside loop, or rotating and tumbling. Positive linear acceleration occurs when velocity is suddenly increased as the body moves in a straight line—in an express elevator, for instance, or the blast-off of a rocket. These sudden changes decrease the amount of blood going to the brain and have the effect of slowing down reaction time to visual and auditory stimuli (Canfield, Conrey, and Wilson, 1949). Tightly fitted pressure suits have been developed which "keep the blood in place" and counteract these effects to some extent.

1. A discussion of human performance in some of the complex stimulus situations modern man must face will be found in the article by John W. Senders in Reference Manual Section B.

VIGILANCE

After only five minutes of being on watch, performance was markedly below what it had been on the pretest, and it continued to drop during most of the hour. Note that performance was better on the visual task than the auditory one on both the pretest and the posttest but was poorer during the actual conditions of the watch.



Based on Buckner et al., 1960

Perception and Vigilance

Our vast national defense effort throughout the cold war has brought the development of numerous devices for detecting the presence or approach of hostile forces, be they aircraft, missiles, or submarines. Such protective devices rely ultimately on the accuracy with which a human operator can observe under conditions of vigilance. A vigilance task is one which requires the detection of specified changes in the environment over extended periods of time. The changes to be detected are usually small and their time of occurrence cannot be predicted in advance by the operator (Mackworth, 1950; McGrath, Harabedian, and Buckner, 1960). Under such conditions the human operator's accuracy declines rapidly. *

Recent surveys of the published literature on vigilance support the following conclusions

(McGrath, Harabedian, and Buckner, 1959; Jerison and Pickett, 1963):

1. The probability of an operator's detecting a signal will decline with time at work. This decline is less rapid if the position as well as the timing of the signals is uncertain.

2. Absolute performance is better when the operator gets more feedback (knowledge of the accuracy of his performance).

3. No selection procedures to pick out "vigilant types" have been developed to date, and it appears that none ever will, because vigilance tasks are highly specific.

4. Introduction of brief rest periods im-

proves the probability of an operator's detecting a signal.

5. The drug benzedrine will eliminate decrement in performance but is recommended only for use in emergency situations because of its possible habit-forming nature.

6. "Distracting" stimuli in a different sensory mode improve accuracy of signal detection. Thus Navy sonar men (auditory signals) made fewer errors when they could scan comic books and look at pictures of "pin-up girls" (McGrath, 1961). When the detection task is complex and difficult, however, distraction hinders accuracy.

PERCEPTION UNDER UNUSUAL CONDITIONS

What happens when sensory stimulation is inadequate or nonexistent? Recent studies have used artificial environments where structured stimulation is almost entirely lacking.

Perceptual Changes after Prolonged Sensory Deprivation

In earlier chapters we saw how *development* is affected by sensory deprivation in infancy. Studies have also been made of the effects of sensory deprivation on the *functioning* of normal adults. Particularly as space travel becomes a reality, it is important to know the effects of prolonged isolation on human beings.

In some studies of sensory isolation, an attempt is made to come as close as possible to *eliminating* visual and auditory stimulation. The subjects remain in a silent, dark chamber in which they are free to move around, and are supplied with food and lavatory. Subjects have remained in such chambers up to ten days.

In one recent study, subjects lay on an air mattress in a dark, soundproof chamber. They wore earmuffs to deaden any sounds that they might make inside the chamber. They were instructed to lie quietly on the mattress without engaging in any unnecessary physical

or vocal activity. Toilet facilities, a food chamber, a "panic button," and an air-conditioning unit were all provided. The subjects were requested to spend one week in the chamber; they were, however, given no information as to the passage of time. The only intrusions on the conditions of isolation were occasional test sessions of approximately forty-five minutes duration for the appraisal of intellectual abilities. During these periods, a 15-watt red bulb lighted the chamber.

The experimental group consisted of sixteen subjects, four of whom were women. All spent the requested week in the chamber; one stayed eight and a half days, and another ten days. In general, the women withstood the isolation for longer periods than the men.

Before the experiment, and once a day during isolation, the subjects were asked to estimate the passage of various specified time intervals. During these intervals the subjects were asked to keep their minds as blank as possible. The only significant difference in time estimation under the experimental and control conditions was in estimating two hours—the longest time interval used. Under experimental conditions there was a greater tendency to underestimate the interval.

Eleven of the subjects experienced hallucinations—mostly flashes of light, flickering lights, dim glowing lights, and so on, which lacked shape and usually appeared in the peripheral field of vision. The hallucinations were usually of very short duration, about five to ten seconds, although some were reported to last for as

long as fifteen minutes. Many subjects reported only one or two brief hallucinatory periods a day; others only one or two during the entire week. Five reported no hallucinatory activity; the women appeared less prone to hallucinations.

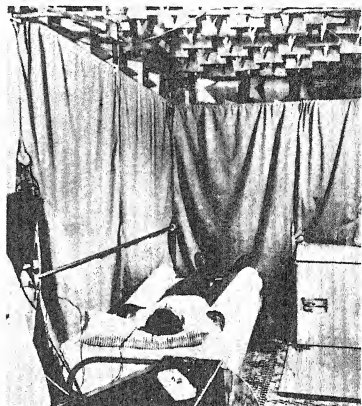
In addition to visual hallucinations, several auditory hallucinations were reported. These were usually very realistic, such as howling dogs, a ringing alarm clock, and the sound of a typewriter. Two tactual-kinesthetic hallucinations were also reported. One consisted of cold steel pressing on the subject's forehead and cheeks; the other was a sensation of someone pulling the mattress from under the subject. In most instances, the auditory and tactual hallucinations were reported during the last two days of isolation.

On first emerging from the chamber, subjects reported that images were more vivid than previously experienced. Hypersensitivity to sounds was also very common, especially during the first night after the experiment, when subjects were aware of even the slightest sounds. Many sounds which normally are irritating seemed pleasant and in some cases were even considered delightful. Traffic noises seemed particularly loud and somewhat startling. Tests administered after isolation, however, showed no gross perceptual changes, and the minor changes in sensitivity disappeared shortly after the first day (Zubeck, Pushkar, Sansom, and Gowing, 1961).

Other studies of sensory isolation have involved depriving the subject of all *structured* stimulation. In some such studies the subjects are enclosed in chambers in which diffused light is seen through translucent goggles, to prevent any pattern vision. A buzzer or other meaningless sound blocks out meaningful sounds of the environment; cardboard cuffs restrict movement and eliminate tactual stimulation of the hands and arms. In some studies subjects have been put into tanks of warm water. More elaborate hallucinatory experiences followed by perceptual distortions have typically been reported under such conditions, which can usually be endured for only two or three days even when the subject is paid a fee of \$20 per day.

In one study in which a low level of diffuse visual and auditory stimulation was present, the subjective reports indicated that when first in isolation the subjects thought about realistic problems but as time went on they had

■ Studies of the effects of sensory deprivation have been carried out by the United States Air Force using rooms like this one. The subject lies in darkness and complete silence, with arm-length cuffs to minimize tactile stimulation.



difficulty concentrating and just "let their minds drift." Finally there were periods in which they thought of nothing and some were confused to the point of being unable to distinguish between waking and sleeping.

Visual hallucinations were generally quite simple at the beginning, but later became more vivid and complex. At first there was a general lighting of the visual field, then dots or lines of light, then geometric figures and patterns. Finally full scenes appeared. One man thought he saw things coming at him and withdrew his head accordingly when this occurred; one was convinced that pictures were being projected on his goggles; another felt that someone was with him in the cubicle. These hallucinations were more vivid than normal imagery and appeared to be projected as on a movie screen in front of the subject, rather than between his ears as is normally the case with imagery.

To test what effects the diffuse light had on hallucinatory activity, the experimenters removed some of the hallucinating subjects to a dark room. At first the hallucinations became more vivid, but within two hours they

were either gone or greatly diminished. When returned to diffuse light, the subjects again hallucinated.

When the subjects were taken from isolation and seated in a chair, with their goggles removed, they were asked to describe their surroundings. Nearly all subjects reported gross perceptual distortion. This lasted for only a few minutes, except in one case which lasted for several hours. Examples of this distortion were movement of objects in the visual field or of the walls of the room, objects changing shape and size, and flat surfaces appearing curved (Heron, 1961).

Although most of the work to date has been concentrated on the visual and auditory senses, preliminary experiments on kinesthetic isolation have been carried out at McGill University in Montreal. Interestingly, the isolation of even a small area of the body from stimulation can bring perceptual changes.

An area of the forearm (which had been tested for sensitivity and compared to a corresponding area of the other arm) was covered with a plastic cup 3 x 6 cm. with a perforated top to maintain skin ventilation. When tested after isolation, this area showed significant changes. When the area was touched with testing hairs, pain, warmth, or itching sensations occurred. When the area was touched with an object such as a pencil, the subject reported indescribably "queer" sensations (reported in Heron, 1961).

It seems clear from present experimental findings that meaningful sensory experiences are necessary for the normal functioning of the brain. Sensory isolation may be thought of as a means of "destructuring the environment." The subject, made anxious by the lack of space and time orientation, has a tendency to try to restructure the environment and restore meaning to the situation. In this attempt, the fantasies, hallucinations, and perceptual distortions that appear are in accordance with the subject's personality and past environment, as well as with the experimental setting (Ruff, Levy, and Thaler, 1961).

It has been suggested that sleep imposes a sensory or "afferent" isolation upon the sleeper. Contact with reality is broken, and the sleeper, in order to maintain a meaningful environment and thus maintain perceptual and cognitive organization, may be forced to hallucinate visual-

ly—to dream (Kubie, 1961). This hypothesis is consistent with the observation that psychotics, who are unable to maintain contact with "real" stimulation, have elaborate hallucinations.

Can dreaming, then, be thought of as a means for maintaining contact with reality serving a necessary function in preventing mental disturbance? Investigations of the value of dreaming have seemed to give support to this theory. Recent research suggests that there is a need for dreaming.

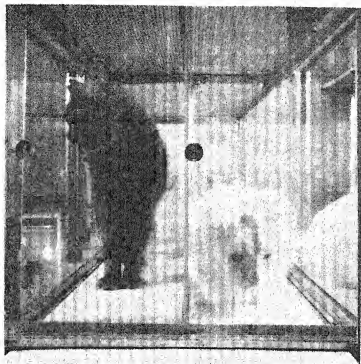
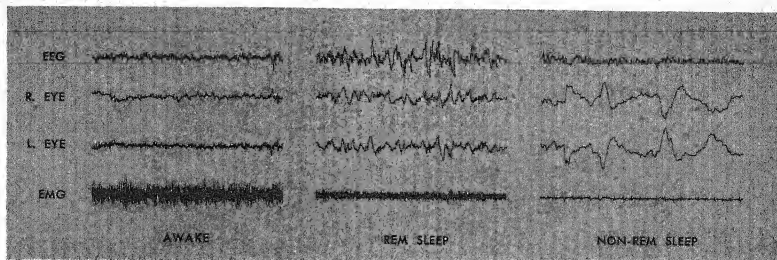
Subjects were "wired" for EEG recording; the experimenter was in another room with the electroencephalograph. As each subject slept, the experimenter watched carefully for the eye movements that indicate dreaming. As soon as such movements were detected, the experimenter would ring a bell in the subject's room, ask him if he had been dreaming, and talk to him for a few minutes by means of an intercom to be sure he was fully awake. The subject would then be allowed to go back to sleep, but would again be awakened as soon as he began to dream.

The usual four or five dream attempts per night rose to ten attempts on the first night dreaming was interrupted and to as many as thirty on the fifth night. Daytime behavior also changed considerably, with increases in irritability, anxiety and tension, difficulty in concentrating, and memory lapses. A majority of participants who were awakened more than three consecutive nights reported a marked increase in appetite and gained an average of a pound a day.

After five nights of dream interruption, the subjects were allowed to sleep through the night. On the first night of normal sleep, subjects who usually dreamed 80 minutes dreamed as long as 150 minutes.

To be sure that the observed changes in behavior were not due merely to loss of sleep, the experimenter repeated the experiment with the same subjects, awakening them the same number of times, but only during nondreaming periods. Under these conditions, none of the signs of upset were present, apparently indicating that the emotional imbalance had been the result of the shortage of dreaming (Dement, 1960).

Later investigations have shown that the sleeper passes through different stages of sleep in the course of the night; one of these is the rapid eye movement (REM) sleep during which there is central nervous activation and dreaming, with inhibition of muscular activity. ▲ Animals,



▲ Only recently has it been determined that there are two distinct kinds of sleep and that the one during which dreaming occurs differs physiologically from other sleep in several measurable ways. Besides its distinctive EEG pattern, there are rapid eye movements, a high level of cerebral blood flow, a higher brain temperature, and a generalized inhibition of muscle activity. The records above show the characteristic patterns of EEG's, right and left eye movements, and muscle activity of a human subject during the waking state, during non-rapid eye movement (NREM) sleep, and during rapid eye movement (REM) sleep. These same two kinds of sleep have been found in all mammals studied so far. The picture at left shows cats being prevented from REM sleep by a slowly moving treadmill on which the animals can doze but not quite reach the REM state.

too, become hyperactive and hypersensitive after REM sleep deprivation. After deprivation, the individual compensates by making up, at the first opportunity, the amount of REM sleep he has missed—even when a period of adequate REM sleep has intervened. Infants show a high percentage of REM sleep and may need it for normal development (Dement, 1965).

In interpreting the results of experiments on dreaming under conditions of laboratory observation, there is always the question of whether the laboratory situation itself plays a role in determining dream content. In a study of this question it was found that on the first night of sleeping in the laboratory, the subjects reported

dreams dealing directly with the experimental situation, and these dreams were anxiety laden. On subsequent nights, however, this influence was reduced, although there was a tendency for the first dreams of the night to be related to the experiment (Dement, Kahn, and Roffwarg, 1965). Thus it appears that several nights must be spent in accommodating subjects to the laboratory situation before meaningful work can be started.

Extrasensory Perception

Are there forms of perception that circumvent all the known sensory channels? Large

amounts of publicity have been given to clairvoyance and mental telepathy. As a result, the psychologist often is asked, "Is there really such a thing as extrasensory perception?"

Extrasensory perception, or ESP, is said to comprise (1) *mental telepathy*, in which one person becomes aware of what another is thinking without sensory cues, and (2) *clairvoyance*, in which an individual becomes aware of a physical object without using his sense organs. J. B. Rhine, one of the leading workers in this controversial area, and others who are convinced that extrasensory perception occurs, are also investigating the possibility of "incorporeal personal agency," which is closely related to the ancient question of whether there is personal survival after death (Rhine, 1960).

A typical mental telepathy test is conducted as follows: There is a deck of twenty-five cards containing five cards for each of five symbols—star, circle, square, plus sign, and parallel wavy lines. After the cards are shuffled, one subject (the "sender") goes through the deck, concentrating on each card in turn, while another subject (the "receiver") tries to read his mind. As the receiver calls out "square," "circle," and so on, his judgments are recorded by an observer. In clairvoyance experiments, the cards are shuffled and the receiver (there is no sender other than the cards themselves) attempts to record the order of the symbols in the pile of cards.

Thus far, ESP investigators have not succeeded in designing experiments which give the same or comparable results when repeated by other investigators. This has made it impossible for most scientists to recognize ESP as a proved phenomenon (West, 1956; Nicol, 1956).

CHAPTER SUMMARY

Although the *physiological sensitivity* of the organism sets a basic limit to what we can know of our surroundings, our observation of the world is also dependent upon the closely related processes of *attention* and *perception*.

Attention, a process of *psychological selectivity*, involves an adjustment of the body and its sense organs, clear and vivid consciousness, and a set toward action. The postural aspect of attention corresponds to the *orienting* or *attitudinal reflex* discovered in lower animals by Pavlov.

Animal experiments have shown that the central nervous system selects some stimuli and suppresses reaction to others. This is made possible by the centrifugal or "wrong-way" nerve pathways, which go from the brain down to the relay stations of the sensory pathways and also from the motor pathway (corticospinal or pyramidal tract) to the hindbrain. The centrifugal auditory pathway, a bundle of nerve fibers from the brain to the ear, is called the *bundle of Oort*. These and the other "wrong-way" fibers act like electronic gates to block response to certain stimuli and allow the organism to pay attention to more important ones.

Certain characteristics of the stimulus object—such as *change*, *size*, *prepotency*, and *repetitiveness*—help determine which stimuli win out over competing ones in attracting our attention. Equally important are such subjective factors as the *organic condition* of the individual, his *interests*, and his susceptibility to *social suggestion*. Attention shifts constantly from one aspect of a situation to another. It also fluctuates involuntarily, even when the sense organs are adjusted to a particular stimulus. *Distractions* interfere with attention, although the amount of interference depends greatly upon subjective factors.

Perception is an active process, midway along a continuum from direct sensing to thinking, by which we organize and give meaning to the information we receive through our senses. Through perception we maintain the experience of a continuing, stable environment despite the constant changing of sensory stimuli. Perception is partly a process of *filling in*, enabling us to interpret a series of fragments as a whole when sensory data are incomplete. An *illusion*, or false perception, seems false only when we compare it with what we know to be true. "Visual cliff" experiments with infants indicate that there is some innate patterning of perception, although past learning usually plays a vital role.

A number of factors operate to make us or-

ganize stimuli in a particular way. Some of these are characteristics of the stimulus object or situation—for example, the *nearness* of various elements to each other or their physical *likeness*, the *inclusiveness* of one perceptual pattern as opposed to another, the tendency to see a complete object (*closure*), and the context, or *part-whole relationships*, of a situation. The way we perceive things—particularly in ambiguous situations—also depends upon such *personal factors* as a tendency to create and maintain a stable structure, our particular past experience, our organic condition, and our needs and values. *Social and cultural factors* encourage the development of certain perceptions and render the development of others less likely. Zulus reared in round buildings, for example, are less subject to the trapezoidal illusion. Our deep-rooted basic classifications of experience, which strongly influence perception, are known as *schemata*. Success or failure may also affect perception. There is evidence of *perceptual defense* against stimuli with socially unacceptable connotations. Direct social suggestion can also influence what we see.

The *accuracy of perception* can only be inferred from an individual's report of what he has seen. Often perception is inaccurate, largely because of poor attention.

The senses interact, and stimulation in one sensory mode can change the perception in another. The tendency to have sensations in one sensory mode when another is stimulated is called *synesthesia*.

In the perception of *depth and distance* of objects in three-dimensional space, we use cues provided by the *stimulation of muscles* in and around the eye (the principal cues to depth available for monocular vision), by the *convergence* of the eyes, and by *retinal disparity*. We also rely on cues from the stimulus pattern itself: *distinctness*, *atmospheric perspective*, *linear perspective*, *texture*, *light and shadow*, *relative position*, and *known standards*. In perceiving *motion* we use cues provided by the changing relationships between various objects and, in the case of radial motion, by the changes in the size of the retinal image.

When a sound comes from one side or the other, the sound waves stimulate the two ears differently and thus give us cues as to the di-

rection of sound. We interpret the *distance* of sound by using cues of *loudness* and *timbre*.

Time perception is influenced by our sense of the sequence of events, our memory of the past, our feeling of how long it has been since a certain event occurred, and our orientation toward the future. Accuracy of time perception is affected by changes in body temperature, which affects rate of bodily activities. Accuracy increases with age, and subjective (felt) time is also influenced by *motivation*. Drugs may affect the apparent length of time.

Reaction time, the speed with which we act in relation to a perceived situation, is measured by apparatus consisting of a stimulus key, a reaction key, and a device to check the accuracy of the timing mechanism, or *chronoscope*. In general, men have faster reaction times than women. Speed of reaction increases with age until about thirty, after which it decreases. Reaction time is influenced by the *sense organs* involved, the *strength of the stimulus*, the nature of the *fore-period*, *motivation* to respond, the amount of *practice* we have had in responding, the *complexity* of the stimulus situation, and various special factors, such as body temperature or amount of radial or linear acceleration (*g*). In *vigilance* tasks the operator's accuracy soon falls far below his maximum but can be aided by brief rest periods or by the presence of distracting stimuli (if the task is simple).

Experiments on *sensory deprivation* show that normal psychological functioning requires sensory stimulation. Low-level, ambiguous, or unstructured stimulation such as diffuse light produces more hallucination and is more difficult for subjects to endure than no stimulation at all. Hallucinations and perceptual distortions are in accordance with the subject's personality and past environment, as well as with the experimental setting. Recent research suggests that there is a need for *dreaming*, or at least for *REM sleep*, the kind of sleep during which dreaming occurs.

Research on *extrasensory perception* (ESP), which is said to comprise *mental telepathy* and *clairvoyance*, over a period of several decades has failed to produce clear-cut, universally accepted results. Most scientists do not regard ESP as a proved phenomenon.

Chapter 10

Outline

KINDS OF THINKING

AUTISTIC THINKING
REALISTIC THINKING
SIMPLE FORMS OF THINKING

THE MECHANICS OF THINKING

THE ROLE OF THE BRAIN
MUSCULAR ACTIVITY IN THINKING
THE IMPORTANCE OF SENSORY FEEDBACK
CYBERNETICS

TOOLS IN THINKING

IMAGERY IN THINKING
LANGUAGE IN THINKING
CONCEPTS IN THINKING

SOLVING PROBLEMS

TRIAL AND ERROR
INSIGHT
STEPS IN PROBLEM SOLVING
PROBLEM SOLVING AS "GAP FILLING"
STRUCTURES
DECISION MAKING
INDIVIDUAL FACTORS IN PROBLEM SOLVING

CREATIVITY

CHARACTERISTICS OF CREATIVE PEOPLE
CAN CREATIVITY BE IMPROVED BY TRAINING?

INFORMATION THEORY

PARTS OF A COMMUNICATION SYSTEM
SIGNALS AND NOISE
FEEDBACK IN COMMUNICATION

Chapter 10 Thinking and Deciding

Thinking involves the manipulation or organization of elements of the environment by means of symbols rather than overt activity.

A good carpenter, for example, thinks ahead and plans his own work or works from an architect's plan rather than building by a "cut-and-try" method. The symbols that man uses are many and varied and include words, numbers, gestures, pictures, diagrams, and visual images.

When you look at an architect's plan of a house, you do not actually see the rooms in the house. Nevertheless, by studying the diagrammatic presentation you can form a clear picture of their arrangement. You can mentally transform the network of lines into a three-dimensional image of the house itself, locate the baths, decide if there are enough clothes closets and if they are in the right places. By manipulating the graphic and verbal symbols of the plan, you can decide how you would place the furniture, or where overnight guests would sleep.

It is possible to manipulate symbols entirely "in your head" without any external stimulation at all, as when you plan to leave a few minutes early to stop at the library on the way to class. On the other hand, thinking may involve perception of graphic symbols, as in the case of the blueprint, or perception of an object itself, as when the sight of an overdue book on your study table reminds you to route yourself by way of the library.

Just as there is no fine line between thinking and perception, there is none between thinking and learning. As we shall see later in this chapter, thinking is involved in learning and learning is certainly involved in thinking. Sometimes, as is often the case in learning, thinking involves solving a problem, but this is not al-

ways true. Dreaming—night dreaming or day-dreaming—is also thinking.

KINDS OF THINKING

On one dimension, thought ranges between two extremes—autistic and realistic. *Autistic* thinking is determined primarily by our own needs and wishes and feelings, whereas *realistic* thinking is determined largely by the requirements of the objective situation. Autistic thinking may frequently be indulged in for self-gratification without regard to reality, whereas realistic thinking tends to be productive—to be directed toward action or the solution of a problem. Both, however, are motivated in that they serve some purpose for the thinker.

Autistic Thinking

Fantasy, dreams, and wishful thinking are all examples of autistic thinking, which is thinking as an end in itself and not as a means to an end. A little dreaming by day or by night is considered normal and harmless and, as we have seen (p. 332), may even be necessary for efficient functioning. Some inventors and artists have reported that a significant idea first came to them in a dream and then was evaluated and elaborated in a waking state. As a rule, however, dreams and fantasies do not stand up very well in the light of everyday reality. What seems to be a "spark of genius" in a dream may be found on awakening to be a very poor idea.

Often a person who is dissatisfied with his everyday life has daydreams of success and gratification. No harm is done unless these dreams become so satisfying that the individual no longer seeks real achievement. This mechanism can be seen in an extreme form in the delusions of grandeur common to many psychotics.

Most thinking is probably shaped somewhat by both inner and outer determinants: reasoning is notoriously subject to distortion by the wishes and prejudices of the reasoner, and daydreams may be prompted by problems that are quite real and accurately perceived. The creative imagination of the scientist or inventor represents an application of highly imaginative thinking to the service of reality.

Realistic Thinking

Contrasted with autistic thinking is realistic thinking, or *reasoning*, which helps us to adjust to the real world. Reasoning is often motivated by the need to reach solutions to problems involving an individual's livelihood or his very survival. It may also be engaged in for sheer pleasure, as by the chess player or the worker of crossword puzzles. Both laboratory experimentation and the technique of factor analysis give evidence that three somewhat different processes may be involved in realistic thinking.

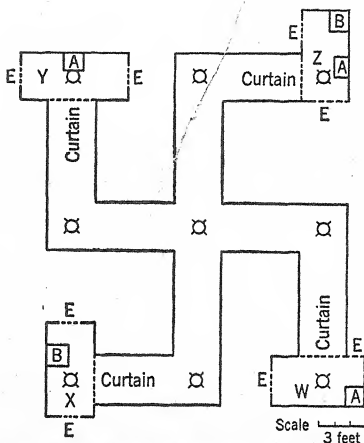
Deductive thinking. Reasoning may be a matter of "putting two and two together"—combining bits of knowledge previously obtained on separate occasions or drawing conclusions from available data. This is a process in which the individual's thinking converges toward the correct answer that is implicit in the evidence. Such thinking has been demonstrated with both animal and human subjects; the apparatus used in one study of reasoning in children is shown in the diagram.

In this study reasoning was operationally defined as the ability to combine the essentials of two isolated experiences in such a way as to achieve a goal.

The child was first allowed to explore the apparatus to become familiar with its various parts and then was removed by the experimenter via a predetermined booth, Y. He was led around the apparatus by a devious

route to another booth, W, where there was a toy windmill which played music when a penny was dropped into the chimney. To test the subject's reasoning ability, the experimenter then took him to another booth, X, gave him a penny, and told him to look for the windmill. The child could go directly from X to W only by integrating two isolated experiences—general knowledge of the apparatus and knowledge of where the windmill was (Maier, 1936).

Deductive thinking is the kind of reasoning exemplified by the syllogism: "If A is true and B is true, then C follows necessarily." Later in the chapter we will have more to say about using the form of the syllogism to test the accuracy of one's thinking.



This is the plan of the apparatus used by Maier to test reasoning ability in children. The four booths at the ends of the pathways are labeled W, X, Y, and Z. The booths were separated from the pathways by curtains. The dotted lines marked E represent curtained entrances and exits. Adults' chairs are indicated by A, children's chairs by B. The position of lights is also indicated.

Inductive thinking. In many cases, there is not a single right answer and the requirements of the situation cannot be met simply by putting together the available evidence. Something new must be added by the thinker, and more than one solution may be appropriate. Such a situation calls for *inductive* reasoning. Here the thinker builds from the known to the unknown. From the known, he makes an intuitive leap, formulates a new hypothesis about what future observations may reveal, or suggests several new lines of exploration. This is the essence of creative thinking, whether in science or art. (Deductive thinking, too, may be creative when the thinker sees relationships that are not readily apparent.) In inductive reasoning the thinker, through imagination, adds something new, something not directly derivable from the data on hand.

Because it is a form of reasoning that leads potentially in any of several directions instead of one and is essentially unpredictable, inductive thinking is harder to produce or study in the laboratory than is deductive thinking. Progress has been made, however, in identifying some of the factors that foster or inhibit inductive thinking. Some of these will be discussed later in the chapter.

Evaluative thinking. A third kind of reasoning is evaluating—judging the soundness or appropriateness of an idea or product. Critical thinking is evaluative—it involves judging the suitability or goodness or effectiveness of an idea or representation, as distinguished from trying to create or add to it.

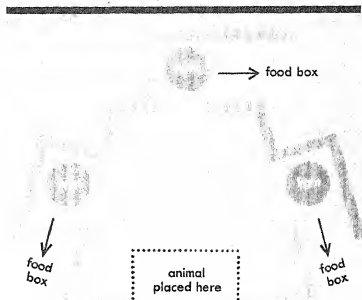
As with deductive thinking, the validity of the result depends not only on the reasoning process itself—here the evaluating—but also on the standard used. If the standard is faulty, a solution judged “appropriate” may not fit the real requirements of the situation.

The relation of these three processes to other cognitive processes and to the kinds of *content* and the *products* of thinking was discussed in Chapter 5.

Simple Forms of Thinking

Surprising as it may seem, animals are able to carry on the process of thinking in the same

■ This drawing shows the type of apparatus used in Hunter's delayed reaction studies.



Based on Hunter, 1913

general way as man, although at a simpler level. One of the first essentials of the thought process is the ability to carry an image or symbol in the memory until it can be used in a different context. A number of tests of *delayed reaction* have revealed that animals are able to carry images or symbols for varying lengths of time.

In an early experiment animals and children were conditioned to expect food in whichever of three compartments was lighted, and a mild electric shock if they attempted to enter a dark compartment. After this learning was well established, a subject would be put into the apparatus and the light would be turned on in one of the compartments. Before the subject was allowed to go to the compartment, however, the light would be turned off, and there would be a brief waiting interval. The delay period was gradually increased until there was marked inaccuracy in selecting the proper compartment.

Rats and dogs were unable to respond correctly, after even a few seconds, unless they kept their heads turned toward the correct compartment. Raccoons and children, however, could move about freely during the delay period and still choose the correct compartment (Hunter, 1913).

In later experiments, monkeys showed the ability to remember for several hours which of two identical inverted cups was concealing a piece of lettuce (Harlow, Uehling, and Maslow, 1932).

Ability to retain images in this way, like other abilities, develops gradually in the human being. Infants have been tested by means of a soft rubber ball from which a chick pops out when the ball is squeezed. After the child learns to manipulate the toy, he is diverted and a little later is given a ball which looks just like the first one but has no chick inside. If he looks surprised when he squeezes this ball and nothing happens or if he looks into the hole for the chick, he is given credit for remembering. This seldom happens before the age of one year, and even then the child shows such signs of remembering the chick only about one minute. By the age of two, however, he usually can do so for fifteen minutes (Bühler and Hetzer, 1935).

A more complex form of thinking is revealed by the *double alternation* test. A simple form of this used with children is similar to the game of guessing which hand something is in: the experimenter uses two boxes, placing a piece of candy under either the right-hand box or the left-hand box. In double alternation the sequence never varies. It is always right, right, left, left, right, right, left, left, etc., and the problem is to deduce this sequence. Children under three are unable to solve this problem, but four-year-olds usually can, and children five years old or more tend to verbalize their solutions (Hunter and Bartlett, 1948).

This method of experimentation is not readily applicable to animals, but their ability to learn a double alternation sequence has been tested in other ways, usually by means of a simple maze. Such a maze consists of a central alley at the end of which the subject may turn either to the right or to the left and continue all the way around, returning to the choice point. * The double alternation task requires that he turn to the right the first two times, then to the left two times, and so on. The turn is made at the same place each time, rather than in different places, as in "spatial" mazes; hence this kind of maze is called a "temporal" one: the time sequence is the important factor.

Although rats have proved unable to learn the double alternation sequence (*rrll* or *llrr*) without preliminary training in simpler mazes (Hunter and Nagge, 1931), raccoons are able to do so and also to extend the series correctly for two additional turns, *rrllrr* (Hunter, 1928). Monkeys can continue the proper series to a total of sixteen turns, *rrllrrllrrllrrll* (Gellermann, 1931b).

Human beings have also been tested with this type of apparatus or with a stylus maze and, from the age of three on, have been able to solve the problem more rapidly than animals and to continue the series indefinitely (Gellermann, 1931a). Again it is clear that human beings can think better than animals. But it is also clear that animals can think. Later on we shall see how well they can think in still more complex problem-solving situations.

THE MECHANICS OF THINKING

Over the years there has been much speculation and some controversy over the mechanics of thinking—especially in regard to the physical processes involved. Despite the great amount of study devoted to this question, we know much more about *what* the individual can perceive, learn, remember, and think than we do about

the processes by which these activities are actually brought about.

The Role of the Brain

Man has long surmised that the brain is the "organ of thought." Such knowledge, no doubt,

was originally derived by our prehistoric ancestors from observation that persons whose brains suffered massive damage in battle or through accidents lost much of their previous ability to think. Knowing that thought is made possible by activity of the brain, however, is far from knowing just what that activity is.

An important breakthrough in the advance towards an understanding of how brain function underlies mental activity occurred some thirty-five years ago when a German neurophysiologist, Hans Berger, demonstrated that the central nervous system is not a passive "telephone system" but is continuously active electrically. Following his lead, other workers have uncovered a number of relationships between the electrical activity of the brain and mental activity.

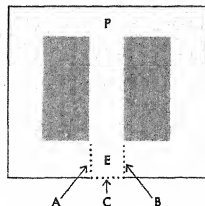
The cortex emits a variety of rhythmic electrical oscillations which go on continuously. These are termed *spontaneous potentials* because they are not evoked by specific sensory stimuli and we do not know what causes them or even how they are related to the action potentials of conducting nerve cells. Electrical responses of the brain to specific sensory stimuli are called *evoked potentials*. The "spike" potentials shown on page 48 are an example.

When these electrical emissions of the brain are recorded by an electroencephalograph, they yield patterns that are highly consistent for a given individual and quite similar in identical twins. Patterns differ somewhat for different regions of the cerebral cortex. It is significant that the brain never rests, even in the absence of special sensory stimuli. In fact, visual stimuli demanding attention stop rather than start the rhythms of the occipital lobe.

Sleep and anesthesia produce large, long waves, whereas alertness or excitement is accompanied by small, rapidly repeated waves. It has also been found that abstract thought and "blankness" go with large waves and that concrete experiences, such as sensation and vivid imagery, are accompanied by small waves. EEG patterns characteristic of waking, REM sleep, and non-REM sleep were shown on page 331.

One psychologist has investigated the development of electrical activity in the brain by studying the brain wave patterns of children of different ages.

● The animal is placed in the apparatus at E and must turn right or left at P, depending on how the problem is set up by the experimenter, who manipulates doors A and B, shown here as broken lines. Door C is opened at the end of a successful run, and the subject finds food outside it.



This study involved recording the waves from the visual area of 132 children ranging in age from a few weeks to sixteen years. It was found that a characteristic pattern of electrical discharge is established at about three months of age, and, once established, is never lost. Its frequency increases rapidly during the first year, then more slowly until the adult level is reached at about twelve years of age. Amplitude increases during the first two years, dropping sharply during the third year and more slowly thereafter, to reach the adult level at about fifteen years of age. The time at which the brain waves are first observed in infants corresponds closely with the appearance of the first evidences of visual perception. This coincidence in time suggests a functional relationship (Lindsley, 1952).

This is the closest we have been able to come so far in correlating brain activity with thinking. Here is a frontier as challenging as the mastery of outer space.

Muscular Activity in Thinking

Many lines of experimental evidence have demonstrated that thinking is accompanied by muscular contractions. These are often so minute that they can be detected only with the aid of a sensitive apparatus which picks up the small but measurable electrical impulses (ac-

tion potentials) produced by contracting muscles. The tiny muscular contractions which occur during thought are called *implicit* speech or gestures.

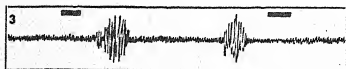
In one experiment, while records were made of the action potentials of the muscle and skin at his right elbow, the subject was told to think of several different actions. First he was told, "Upon hearing the first signal, imagine lifting a 10-pound weight with the right forearm. Upon hearing the second signal, relax any muscular tensions, if present." The results are shown in the record below, with the experimenter's signals indicated by the short bars at the top. There was a sharp rise in electrical activity while the subject was imagining the activity of lifting the weight.



Then the subject was instructed: "Upon hearing the first signal, imagine lifting the weight with the left forearm." The results are shown in the record below, which is similar to that obtained from the instructions, "Do not bother to imagine," or "Imagine bending the right leg."



The following record of muscular action currents was obtained following the instructions, "Imagine hitting a nail twice with a hammer held in your right hand." (Jacobson, 1932).



Similar results have been obtained by many other experimenters. In one study, for example, it was shown that when a person is thinking of a geometric design, his eyes move to form the outline of it (Totten, 1935).

Further understanding of the role of implicit muscular activity in abstract thinking is gained from a highly interesting experiment investigating whether deaf-mutes make tiny "speech" movements with their hands and arms during

thought, comparable to the tiny movements of the vocal apparatus that are made by persons who can speak.

Subjects of the study were sixteen persons with normal hearing and eighteen deaf persons. When they were instructed to imagine that they were performing tasks which would require the use of their arm muscles, the percentage of electrically measured small muscle movements of the arms was the same for the normal subjects as for the deaf ones. In abstract thinking, however, such as multiplying and dividing mentally, the deaf subjects showed measurable action currents in their arm muscles in 84 per cent of the cases, as against 31 per cent for the normal subjects (Max, 1937).

Forty years ago certain behaviorists were trying to prove that thinking actually consists of tiny muscular contractions. Such facts as those just cited are consistent with—though not conclusive evidence for—such a hypothesis. There is no doubt that thinking of some act is correlated with action currents in the muscles that would be used in that act. However, we still lack fully acceptable evidence of the direction of *cause* and *effect*. It is as possible that the thought causes the implicit movement as that the implicit movement causes the thought. Evidence of muscular activity during abstract thought has generally not been forthcoming.

The Importance of Sensory Feedback

Although symbols may be manipulated in the absence of any stimulation, we know from sensory deprivation experiments that in the long run, normal thought patterns require a certain level and heterogeneity of stimulation. Evidently we need to keep checking against "reality" to confirm or alter the assumptions on which we are basing our thinking and action.

One important type of stimulation that we need for coordinated and adjustive action is the sight and sound and feel of our own actions, since each step in an action sequence must be built on what has gone before. It is not surprising that even a slight delay or disruption in the sensory feedback that we normally receive can seriously disrupt not only our action but even our accompanying thought processes.

In one study, subjects were supplied with a specially designed tape recorder and earphones which delayed feedback so that a subject heard his own voice a fraction of a second after he spoke. Under these conditions, most subjects had difficulty in speaking. They stuttered, repeated phrases, were unable to pronounce certain words, and lost control of volume and fluency (Fairbanks and Guttman, 1958).

Evidence that the thinking of such subjects is being disturbed appeared in a similar study where subjects were unable to answer simple questions which they had answered earlier under normal feedback. Common comments were, "I can't think," "I can't remember," or, "If I can't hear what I've said I can't follow my thoughts through" (Zimbardo, 1965).

Cybernetics

To scientists engaged in the development of high-speed electronic computers, certain similarities between these artificial brains and the human nervous system have become increasingly apparent. It has been suggested that the methods of study and analysis involved in computer engineering and experimental neurology are often identical and that each field has much to offer and gain from the other. Slowly these two fields have begun to merge into a single science, named *cybernetics* by Norbert Wiener, one of its principal spokesmen (Wiener, 1948). Derived from the Greek work meaning "steersman" (which is also the source of the word "governor"), cybernetics is defined as the *science of control and communication in the organism and machine*.

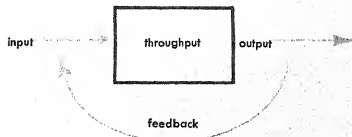
There is today a lively debate going on over the issue: "Can computers think?" Some experts say "yes"; some say "no." One wag has said: "Computers can't think, they just think they can." Regardless of how the debate turns out, computers have become extremely valuable tools.

One of the principal contributions which cybernetics has thus far made to psychological understanding lies in its application of the principles of servomechanisms to human behavior. To understand the concept of a servomechanism we must consider three types of machines.

First, there are machines which are random and nonpurposeful, such as a roulette wheel. Then there are machines which are nonpurposeful but orderly, such as a watch or an ordinary gasoline engine. Such machines are, of course, built for a purpose, but they do not themselves have a built-in purpose; that is, they have no final "goal" or position to achieve but merely continue to operate in an orderly fashion until they either run down or run out of fuel.

There are some machines of a third type, however, which are intrinsically purposeful or goal seeking. Such machines are called *servomechanisms* (Rosenbluth, Wiener, and Bigelow, 1943). An example of a servomechanism is a missile with a built-in target-seeking device which enables it to change its course continuously in pursuit of a moving target until contact is made. Servomechanisms differ from other machines in that they are sensitive to certain stimuli and respond to them. The target-seeking missile, for example, is sensitive to stimuli coming from the target (such as heat) and responds to those stimuli until it reaches its goal, much as a pilot flying a plane by instruments comes in "on the beam." The stimuli act as a source of information to the mechanism, reporting how far it is deviating from its goal. The mechanism is therefore "error sensitive" and is able to respond to stimuli in such a way that its deviation from the right course is continuously corrected. This type of error-correcting information, in machines as in living organisms, is called *feedback*.

A servomechanism is considered to involve four basic processes: input, throughput, output, and feedback. The relationships between these four operations are shown below.



Not only the operations of servomechanisms but the behavior of human organisms can be described in these terms. *Input* refers to the stimuli which initiate the activity of the ma-

chine or organism. These may be external stimuli such as the light waves reflected from a pencil which a person wants to pick up, or internal stimuli such as hunger pangs which direct him to the refrigerator. These stimuli initiate activity within the nervous system called *throughput*; this, in turn, activates muscles which produce a response. Each finite response is an *output*, and the sum total of output in a situation is the behavior pattern, which is culminated when the goal is attained.

Output is continually corrected by *feedback* information. This will be in the form of external stimuli (such as light waves coming from the goal) and internal stimuli (such as kinesthetic cues coming from the muscles). If the organism is deviating from its goal at a given

instant, feedback will indicate what change or correction in the response is needed during the next instant. But if the organism is exactly "on the beam," feedback will not change the behavior. Thus the function of feedback at any given instant is determined by the nature of the response during the previous instant.

The important role of kinesthetic feedback is clearly seen in the case of individuals suffering from *tabes dorsalis*, a disease in which certain spinal nerves responsible for conveying kinesthetic stimuli to the brain are destroyed. Even though there is nothing wrong with their muscles, such individuals have great difficulty in making successful leg movements because they must depend almost entirely on visual feedback.

TOOLS IN THINKING

The nature of the symbols we use in thinking is another subject that has occasioned much study and discussion. Some investigators have maintained that thinking is a manipulation of images; others that thinking requires the use of language. Today it is pretty generally agreed that both of these may be tools in thinking.

Imagery in Thinking

A half-century ago psychologists were deeply concerned with the role of imagery in thinking. Some investigators maintained that thought required the use of images—mental pictures of actual sensory experiences—whereas others held that thought could proceed in the absence of imagery. Subsequent discoveries have supported the second point of view. In one pioneer study, for example, it was found that many scientists and mathematicians, though engaged in the highest and most complicated type of thinking, were actually quite deficient in visual imagery (Galton, 1883). Poincaré, the great French geometrician, described himself as lacking in

the ability to visualize space. Less gifted persons and children, on the other hand, often possess clear visual imagery to a much higher degree. Many people report that they can even dream without the use of images. All this is not to deny that imagery is used in many kinds of thinking, but evidently other kinds of symbols may be used instead.

Most people seem to be strongest in visual imagery. Some, however, are strongest in auditory imagery; and a small minority report that images of touch, muscle movement, taste, or smell are strongest.

In certain cases individuals possess imagery which is almost like actual perception in its clarity and accuracy (Barber, 1959). ▲ These strong images, usually visual, are called *eidetic images*. People with eidetic imagery can frequently tell the exact position of a formula or fact on the printed page of a textbook. They can even glance for a fraction of a second at an object, such as a comb, and then call up such a vivid image that they can give a complete description, including the number of teeth in the comb. In examinations they may "copy" from

their image of the printed page, performing with an accuracy as great as though the book were actually open before them. The following case is an example of eidetic imagery, or, as it is also called, photographic memory.

A law student was called before a disciplinary committee on the charge of cheating in an examination. One of the questions called for the details of a law case given in the textbook. The description turned in by the student was word for word that of the book. The reader had quite naturally concluded that the student had copied from an open book. Upon being questioned, the student defended himself by saying that he had felt that the professor might call for that case and so had looked it over just before class. To test his ability at such exact reproduction of verbal material, the student was given a page of unfamiliar material to study for five minutes. At the end of that period he was able to reproduce some four hundred words without error. Not a single word or punctuation mark differed from the text. He had eidetic imagery.

Eidetic imagery is most often found in children. Although it is comparatively rare in adults, it is not a particularly mysterious phenomenon. Careful investigation indicates that eidetic imagery is simply very clear visual memory (Allport, 1928). It does not appear to play a role in creative imagination which, as we shall see, requires flexibility. Materials stored eidetically are not easily broken down and reassembled in new patterns.

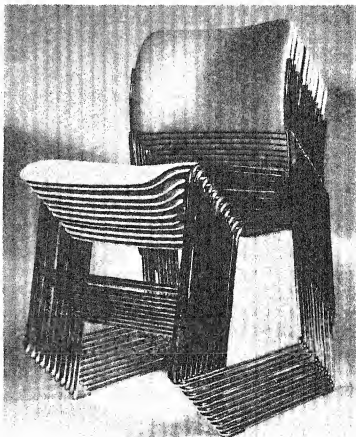
The kind of visualization which is useful in complex thought is not necessarily the same as visual imagery. This fact is brought out in an introspective account by a psychologist who is also a chess master capable of playing twelve boards of "blindfold" chess simultaneously. In what is called blindfold chess, the player does not actually wear a blindfold but sits with his back to the board or boards so that he cannot see the pieces. A referee calls out his opponents' moves to him and he replies with his own. Obviously, ability to visualize what is happening on the board is the primary factor in winning. However, this visualization process is "a summation of many learned skills," more a process of abstraction than a literal visualizing of all details. This psychologist-master has summarized it as follows:

1. As a result of long experience with the game, both the board and the pieces acquire many associations for the player. It becomes impossible to think of the board separately from the pieces or of the pieces with no relationship to the board.

2. It is also impossible to think of the moves separately from the special notation or symbolic language which chess players use to describe their plays. Simultaneous games are kept separate in the player's mind largely with the aid of such symbols. For example, the notation 1P-K4 stands for one possible opening move, while 1P-QB4 represents another, and so on. Games vary greatly in character according to the opening used, and as they progress and differences become greater it is easier, rather than more difficult, to keep them separate.

3. A space-time Gestalt or pattern is formed of the entire board. That is, the position of the pieces changes in space and with time, but the number of plausible changes is limited.

4. A prime factor in skill in chess is the ability to sum up each position dynamically in terms of the most significant elements in it, not to recall all details regardless of significance.



▲ Look at this picture for about three seconds; then read the note at the bottom of page 344.

5. For the most part, the first four phases take place below the level of active consciousness. Once the summation of significant elements is made, the visual image reaches consciousness. Because of the player's capacity to organize the abstract and symbolic data, the "picture" he visualizes consciously is a coherent one (Fine, 1965).

Language in Thinking

The relation of language to thought has long been a subject of interest and controversy. Is thinking merely a sort of inner speaking? Or is speaking actually a hindrance to thought?

In ancient times thoughts were ordinarily identified with words and were imagined as being stored in the body. Homer even spoke of them as "feathered creatures" in the chest (Cohen, 1954). Children, too, often connect thoughts with speech.

A little girl described by Piaget had lost her doll. When asked if she had any idea where she had put it, she replied, "No, I've no more ideas in my tummy. My mouth will have to give me a new idea." "Why your mouth?" asked Piaget. "Yes, it's my mouth that gives me ideas," said the child. "It's when I talk, my mouth helps me to think." Later she commented that it was possible to have ideas even when your mouth was shut, but you couldn't say them, for they were still in your tongue (Piaget, 1952).

Although words are probably not essential to thought and may sometimes even be a hindrance to it, language appears, in most instances, to be an aid in solving problems. Indeed, few of us would want to try to think without it. Words and other symbols can greatly facilitate the solution of problems which would be much more difficult to cope with if we had to rely on the direct manipulation of objects and images. The development of the precise symbolic systems of algebra and calculus, for example, has greatly increased man's ability to

control his environment. If a surveyor wishes to determine the height of some tall landmark, it is not necessary for him to scale the object and measure it directly. Instead, he can set up a sextant at some specified distance from the base of the landmark and measure the angle of elevation from that point to the top of the object. He can then solve the problem by manipulating mathematical symbols.

The power of words to shape our thinking is attested by an early study.

Two groups of subjects were shown the same stimulus figures but were given different information as to what the figures represented. All the subjects were later asked to redraw the figures as they remembered them. The drawn figures were consistently more like the named object than the original figures had been (Carmichael, Hogan, and Walter, 1932).

Another problem concerning the relation of language and thought is the question of how much the particular structure of our language determines what we think. One student of language and culture, Benjamin L. Whorf, has proposed the theory that language patterns, operating unconsciously, play a dominant role in making a person conform to his culture (Whorf, 1956). For example, we saw in our discussion of time perception that some primitive tribes have only one tense for the verbs in their language and thus speak of everything as occurring in the present. It would seem impossible for anyone who spoke such a language to think about past and future time as precisely as we do.

The Hopi Indians have one word which means "pilot," "fly," and "airplane" and have no need for further differentiation of terms. The Arabic language has scores of words for different breeds, ages, and conditions of horses but no generic term for "horse." Eskimos have many different words to stand for kinds and conditions of snow. Obviously Arabs are more interested in horses than in snow and need to be able to think more precisely about them. The reverse is true for the Eskimos and is reflected in their language. Whorf believes that the language patterns of a cultural group are important in determining the thought patterns and even the perceptions of the children reared in that culture.

How many chairs were there in the picture on page 343? If you have eidetic imagery you will still have a clear enough visual image to count them.

In general, the Whorf theory is regarded as a valuable tool for cross-cultural understanding. However, a number of anthropologists feel that the concept of language as the predominant factor in culture represents too extreme a position. They criticize Whorf for taking too little account of the development that occurs before language exerts much influence on the individual (Fearing, 1954).

The Whorf hypothesis also involves the deeper question of what inherent qualities, if any, the cultural influences operate upon. Further research on cultures which are very similar but have totally different language patterns or which have similar languages but differ markedly in other respects may throw needed light on the whole question of the relationship between language patterns and thought (Hoijer, 1954).

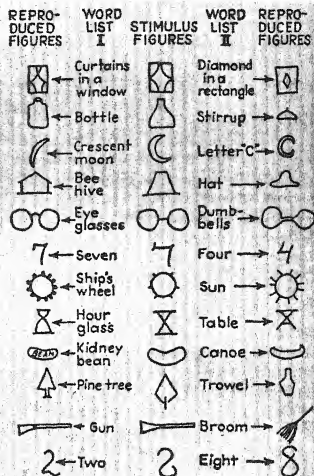
Concepts in Thinking

Much of our education—formal and informal—consists of learning to employ abstract concepts. Such concepts as those represented by the terms “mass,” “velocity,” “energy,” “time,” “distance,” and “inertia” are essential to an understanding of physics.

Technical terms are employed in all sciences and in every type of accurate thinking because the concepts they represent are precise—the limits have been sharply drawn and agreed upon by experts in the field, so that the meaning of the term is clear to everyone who uses it. Such concepts are always derived ultimately from sensory experience with existing things, but they represent no one thing capable of independent existence.

Many other concepts, equally abstract and equally important in much of our thinking, are much less precise than those of science. Your concept of what is morally “right,” for example, is the product of innumerable experiences at home, at school, at church, and as a member of various social and political groups. It may be quite different from that of someone reared in a different culture or even a different home in your neighborhood. Indeed, your own concept of “right” is probably undergoing a continuous process of modification and development. Concepts like this one are necessarily less

Some of the stimulus figures used in this study are shown in the center column, with the word lists presented to the two groups. The outside columns show some of the figures drawn from memory.



precise than the scientist's concepts of “energy” and “mass.”

Concept formation by children. To discover whether a child has formed a particular concept, we simply present him with unfamiliar objects and see if he can identify the ones to which the concept applies. For example, to see whether a child who has learned to call grass “green” actually has acquired the concept of “greenness,” we present him with various objects, some green and others not. We conclude that he has formed the concept of “greenness” if he can correctly apply the label “green” to objects other than grass. Often a child who does not know the verbal label will indicate by his *actions* that he has formed a concept—that is, that he is aware of distinguishing characteristics. The fact that many basic concepts are evi-

dently learned in an infant's early months suggests that language is not necessary to the formation of concepts.

The steps by which a child develops basic concepts of causality, space, and so on have been studied over a period of several decades by Jean Piaget. This unusually ingenious Swiss investigator traced the development of the concept of cause and effect in his own children.

As soon as the child began to pick up objects, at about four and a half months of age, some rattles were placed on a semitransparent canopy over the crib, with a string which the child could pull to make the rattles bounce and rattle. Although a little frightened at first, the child was soon delighted with this arrangement and pulled the string frequently. When a new toy was put on the canopy, he pulled the string. Next, the experimenter, standing out of sight, swung a toy on a stick before the baby and then ceased to swing it. The child pulled the string, and when nothing happened pulled again, harder, watching the toy but ignoring the stick to which it was attached. When the experimenter whistled from a corner and then stopped, the baby looked toward the corner but pulled the string. Evidently pulling the string had become generalized as a way of prolonging interesting events without any thought of distances or points of contact. In fact, when the child was handed an unfamiliar toy that did not make interesting noises when shaken, he used his free hand to pull the cord while eyeing the new toy hopefully.

Similarly, when a toy was placed out of reach on a blanket, the child would pull the blanket, bringing the toy within reach. But until he had reached the age of recognizing independent objects as permanent, he also pulled the blanket when the toy was placed out beyond the blanket so that pulling would do no good (Piaget, 1957).

If a cloth is placed over a watch as a baby aged five to six months is reaching for it, he will withdraw his hand. If a cloth is placed over his face, however, he will remove it, showing that he does not regard cloth as an insurmountable barrier. At seven months, he will reach for a partly hidden bottle, but if it is hidden completely, he cries as if it had gone forever (Piaget, 1957).

Even when a child first begins to search for concealed objects, he apparently does not quite conceive of them as having independent existence.

In one study, the child sat between two pieces of cloth. The experimenter showed him a ball and then put it under cloth A. The child readily got it. But when the experimenter slowly put it under cloth B, the child went back to cloth A. Two other children of the same age (about eight months) showed the same behavior. One kept going back to cloth A for three weeks before he dissociated the toy from cloth A. ■

Behavior of this kind shows that a young baby has no organized conception of space or of movements. When he does begin to form the concept of space, it is centered on his own body and his successful actions, and external objects have no permanence. Only later does he develop a concept of space in which the objects he sees have continued existence in a definite location even when they happen to be out of his sight.

Similar studies showing a gradual development of the concepts of mass, weight, and volume have been conducted by Piaget (1957) and replicated recently with similar findings (Elkind, 1961). Such replication of experiments is exceedingly valuable in establishing a sound, tested body of psychological knowledge.

One hypothesis of concept development in children starts with the premise that successful interaction with environmental objects requires the construction of an internal representation of these external objects and relationships. There is evidence that in the course of cogni-

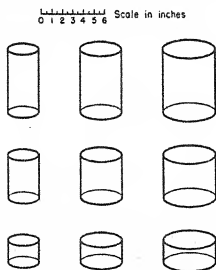


■ If a toy has once been found under Cloth A, a young child will look for it there again even though he has seen it placed under Cloth B.

tive growth three successively more efficient types of representation are built up. The first is muscular: we can climb our back stairs in the dark without tripping or stumbling because we have learned to adapt our movements to the exact height of the risers and even to turns or irregularities in those particular stairs. Without visual cues and probably without even being able to say how many stairs there are we can make the exact motions needed.

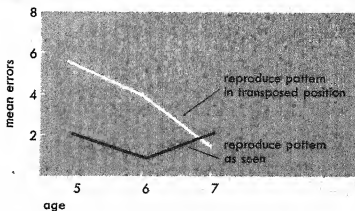
The next type of representation, according to this hypothesis, is through the use of images. Unlike the motor representations, images can serve us in the absence of the objects themselves; presumably it is images that enable subjects to make delayed reactions such as those described on page 377. But images are literal records: they remain similar in form and in their interrelationships to the objects as previously perceived. Not until we become able to construct symbols, such as language symbols, do we have a system of representation which can transcend the exact characteristics of what we have perceived. Images are based on particular perceptual details, whereas symbols may represent inference, abstraction, or transformation according to a rule.

For example, five-year-olds are as proficient as seven-year-olds in reconstructing the following pattern of plastic glasses varying horizontally in width and vertically in height.



After the child has seen them in the positions shown here, he has no trouble replacing any that are removed or putting them back into

▲ GROWTH OF ABILITY TO USE SYMBOLS



Based on Bruner and Kenney, 1966

this order when the experimenter scrambles them. Here only imagery seems to be required. But if one of the corner glasses is put in a different corner and the subjects are asked to reproduce the same pattern in this new orientation, the five-year-olds make twice as many errors as the seven-year-olds in doing so. ▲ Also the children who have the most trouble in making this transformation are the ones who, in describing the arrangement at the beginning, tend to mix dimensional terms like *higher* and *shorter* with global terms like *big* and *little*. The investigators regard these findings as evidence that the older children have progressed further in their ability to translate their experience into a representational system using symbols whereas the younger children are still limited by having only motor or image representations, neither of which allows for transpositions (Bruner, 1964).

The first meaningful words which the child uses stand for single, concrete objects. He will use the word "dog" or "kitty," for example, in reference only to the family pet or some other specific animal. As a next step he will learn to group *many* individual animals into the categories of "dog," "cat," "cow," "horse," and so on. Still later he will learn to group all these animate objects under the single unifying concept of "animal." This process of learning to group objects in terms of some distinguishing common property is called *abstraction*. As a person progresses toward maturity, he develops

and uses concepts at higher and higher levels of abstraction—concepts such as “truth,” “beauty,” “right,” and “wrong.”

A child's early concepts depend heavily on visual similarity between various objects. As he grows older, however, he learns that some things are grouped together which have little or no outward similarity—for example, that dogs and fish and earthworms and birds are all “animals.” He also learns to make distinctions among objects whose superficial characteristics are very similar. From the biologist's point of view, for instance, whales have more in common with dogs than with sharks, because whales and dogs are warm blooded (maintain a constant body temperature) but sharks are cold blooded (tend to maintain the same body temperature as their surroundings).

Much of the questioning that is so characteristic of children helps them to form and sharpen their concepts. The following conversation between a mother and her child of four is typical of this process.

Child: “I'm four, aren't I?”

Mother: “Yes, four years.”

Child: “What's a year?”

Mother: (Explains)

Child: “Is that a long time?”

Mother: “Quite a long time.”

Child: “How long?”

Mother: “It's hard to explain, but it is a lot of days, 365, and that's many.”

Child: “Well, but how long?”

Mother: “Well . . . you know when it was Christmas.”

Child: “Oh, yes, and I had a tree, and once I had the tree in the corner, and once I had it on the table.”

Mother: “Well, that was twice, and it takes a year to have a Christmas. You see we have Christmas, then the time between that Christmas and the next is a year.”

Child: “Well, that's a very long, long time. When I was very small we had a Christmas. Is a year a birthday?”

Mother: “Well, you have one birthday, then the time between is called a year, then you have the next birthday.”

Child: “Yes, three then four—then five—Say, how old are you?”

Mother: “Thirty.”

Child: “How did you stretch up?” (Rust, 1960)

Studies of such conversations give us some indication of the way children develop abstract concepts and are helpful in suggesting problems for closer study, but their results are not dependable because there is not sufficient control of past experience.

In many experimental studies of concept formation, the subject's task is to identify or discover the “correct” concept—the common element in a series of objects or figures. In some cases this means developing a new concept for the first time. In others, it means simply discovering which of several concepts already in one's repertoire, such as “roundness,” “greenness,” or “larger than,” is the “correct” concept. In the following experiment with children, the concept to be identified was *roundness*.

The apparatus consisted of two identical compartments in which stimulus objects were placed. As long as the compartments were lighted from the inside, the stimulus objects were visible through a mirror-screen on the front of the compartments. Each compartment had a hole in its base out of which a piece of candy could come when the mirror was pressed.

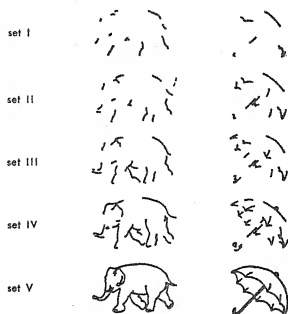
Each subject was brought into the room alone and allowed to play with the apparatus. If he pressed the mirror of the compartment containing the positive stimulus, the lights went off and the piece of candy rolled out as a reward. The mirror was usually pressed spontaneously by the child; if it was not, its action was demonstrated by the experimenter.

After the subjects had learned to select the positive stimulus (always a ball of some sort) instead of the negative stimulus (never a ball), they were tested on a variety of objects to see if the concept of roundness had been identified. All subjects gave evidence of responding to the characteristic roundness by selecting the spherical object more often and by selecting it first from a pair of objects not used in the training. For eleven of the thirteen subjects the concept of roundness was broad enough to include cylindrical as well as spherical objects. When presented with pairs of objects neither of which was perfectly round, the subjects chose the more nearly round one. The older children learned more rapidly than did the younger ones, and those of higher mental age learned more rapidly than those of lower mental age (Long, 1940).

Other studies have dealt with a different aspect of the development of the ability to form

concepts—namely, the gradual decrease in dependence upon direct perceptual stimuli. That is, the forming of concepts involves going beyond the information given and correctly placing objects in broader categories so that they can be dealt with effectively. To do this, the young child requires more sensory cues—a more complete representation of the object—than does the older child or the adult.

This was shown in experiments using five sets of pictures similar to those in the illustration below:



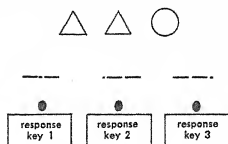
Each set had twenty pictures of common objects. As shown, pictures in Set I were incomplete; those in the other sets increased progressively in completeness to Set V, which consisted of complete outlines. Subjects were presented with Set I, then Set II, and so on until they were able to name the pictures correctly.

In preliminary studies untrained preschool children (aged two and a half to five years) could recognize, on the average, only one of the Set I cards, while the average for college students was 7.55. Training improved the ability of all age groups to recognize the pictures. In one experiment, half the subjects were trained with cards from Set III, which are midway along the continuum of completeness, and half with cards from Set V. When training was conducted with Set III cards, there were no significant differences in mean recognition scores between age groups. In training with Set V pictures, however, significant age differences did appear, with kindergarten and first-grade children making many more errors than adults (Gollin, 1965).

It is expected that further research along these lines will throw light on the periods in development when shifts from perceptual to conceptual functioning are most likely to occur and on the conditions which will hinder or facilitate these shifts.

Recent investigations of the development of mathematical concepts in children suggest that such concepts may be formed on an all-or-none basis rather than by gradual steps.

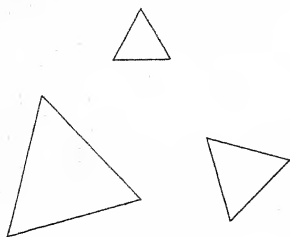
This was indicated by individual learning curves obtained in an experiment in which seven- to eight-year-old Belgian children were shown simple patterns like those illustrated below.



The three stimulus patterns were shown on a screen well above the three dot-dash patterns, which remained the same on every trial. The stimuli were varied on each trial, but always two were alike and the third was different from them. The position of the odd stimulus was varied at random from trial to trial. Below the dot-dash patterns were response keys. The child's task was to press the key below the pattern in which the dot was in the same position as the odd stimulus. In the example shown, the correct response key was No. 3. Had the circle preceded the two triangles, the correct response would have been No. 2. The learning curves on page 350 show the all-or-none, or sudden acquisition, pattern of arriving at the concept of similar position of odd elements. Similar patterns appeared in the curves obtained in experiments dealing with more complex mathematical concepts (Suppes, 1966).

An interesting cultural effect appeared in a study of geometrical concepts. Mathematicians have studied the mathematical properties that remain invariant under transformations of a geometrical space. (In Euclidean geometry, the properties of figures remain invariant under the group of rigid motions, such as rotation of the figures.)

In an effort to determine what geometric properties children consider most invariant, stimulus displays similar to the one below were shown to school children in the first, fourth, and sixth grades.



The child's task was to indicate which of the two lower figures was more like the figure at the top. First graders showed a very strong tendency to choose whichever figures showed least rotation, regardless of other factors, such as size. That is, they would probably choose the figure at the left in the illustration. This tendency was considerably less evident with fourth graders and still less so with sixth graders.

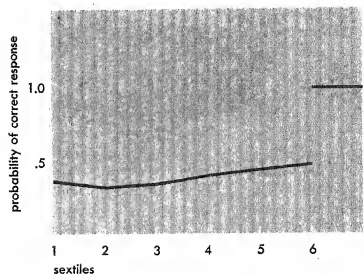
This finding seemed to indicate that maturation might be involved, especially since other studies had shown that animals have much greater difficulty in recognizing a rotated pattern than one which is simply changed in size. However, further experimentation showed that the preference for minimally rotated figures did not hold for first-grade children in Ghana, Africa, or for American nursery-school children. This casts considerable doubt upon the hypothesis that maturation is the primary factor. The investigators concluded that the emphasis on reading in the first grade had taught the American first graders that a letter is the same regardless of its size and that words can be distinguished on the basis of the relative orientation of the letters they contain. Thus they used position rather than size as a cue in determining similarity. Ghanaian first graders and American nursery-school children, on the other hand, have as yet had little work in reading (Suppes, 1966).

Concept discovery beyond childhood. There have been many laboratory studies of strategies in concept discovery and of the factors that facilitate or make difficult the identification of the element common to a class of objects. One early study made use of Chinese characters.

College students were shown a series of thirty-six Chinese characters, which, unknown to them, fell into six "families" of characters; all the items in each family had some common identifying element. Each character was followed by a sound, the same sound being used with all the characters in that family group but never with characters from another family. For example, the character 沛 was presented with sound oo; the character 祖, with sound ver; the character 笑, with sound fid; and so on. Characters possessing different elements were presented in random order.

The subjects were not told that the experiment involved the abstraction of concepts representing common elements. They all thought that they were doing a memory experiment. As each character was shown, subjects tried to name it by giving its sound before the experimenter presented it again.

When the subject could give the proper sound for each character in six trials, he was tested with entirely new characters possessing the same common elements



Based on Suppes, 1966

ALL-OR-NONE LEARNING OF CONCEPTS

This is a special type of learning curve called a *Vincent curve* in which the subjects' scores prior to reaching criterion are plotted at equivalent stages of mastery instead of being averaged for each successive trial. Here scores were plotted for each sixth of the trials up to and including the last trial before criterion was reached. Little or no improvement occurred during this period, but once criterion was reached, on the following trial, no more errors occurred. The time required to respond also dropped sharply when criterion was reached.

that he had learned to name before. This was done to see if the common element had in fact been abstracted.

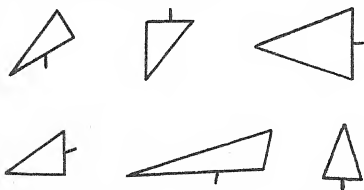
Eventually most of the subjects learned that characters such as the following, all called *oo*, had a common element: the "check mark with two half-moons in it."

洋 永 添 港

Analysis of each subject's results showed that "individual concepts usually come into consciousness very gradually. Erroneous first impressions were either discarded or transmuted into the correct form by a continuous development. Trial and error plays, if not a dominant, at least a very important role in the process."

To determine the principles that govern efficient learning of concepts, the experimenter repeated the procedure with variations to make the common element more easily recognized. He found that the most effective method among several tried was to present the series of characters with the common element drawn in red so that it would stand out. His conclusion with regard to concept formation was labeled "the principle of dissociation" and is stated in the author's own words as follows: "What is associated now with one thing and now with another tends to become dissociated from either, and to grow into an object of abstract contemplation." (Hull, 1920)

Several lines of evidence indicate that verbalization is not essential to the abstraction of a common element. One experiment used figures as those shown below.



It was found that subjects could often classify the objects on the basis of their common elements long before they could actually explain the principle they used. The task was to distinguish between "mibs" and "non-mibs." A "mib" was a triangle with a line extending at right angles from its shortest side (Smoke, 1932).

The following is an example of a study investigating the strategies used by subjects in discovering the common element among several possibilities.

The subjects were shown eighty-one cards, which varied as to color, symbol (cross, circle, or square), number of figures, and type of border. Thus a card might show one red circle with a double border, two green squares with a single border, or perhaps two green crosses with a double border. In each problem the one "correct" concept was to be discovered by the subject from the cards displayed to him.

It was found that two general methods or strategies were employed by subjects in arriving at the concept. In one, the "focusing" strategy, the initial card as a whole was made the basis of a hypothesis. The subject then compared subsequent cards with his memory of the original one, looking for the features they had in common with it and ignoring other features. In the second, or "scanning" strategy, the subject would bet on one aspect of the original card, such as its color, as being the basis of similarity. He then had to change his hypothesis whenever he met a contradictory instance and had to remember other features of the first card so as to form a new hypothesis. The subjects who adopted the focusing method did better on the whole than did the scanners, although they were equally affected by increased difficulty of the problem. When time pressure was applied, 63 per cent of the focusers were successful as compared to only 31 per cent of the scanners (Bruner, Goodnow, and Austin, 1956).

A skillful teacher can greatly hasten the process of concept formation by pointing out instances of the common element (Johnson, 1955). The concept of "mib," for example, would have been easier to learn if all the "mibs" in the diagram had been marked *M*.

The informational approach to concept formation. A relatively new way of studying concept formation and other aspects of thinking is the *informational approach*. According to this theory, thinking is essentially a process of transfer from a situation in which information is acquired to another situation in which the information must be put to use but cannot be utilized in its present form. This definition excludes those situations in which information is simply recalled or used unchanged. In the high-

est forms of thinking, involving creativity, to be discussed later in the chapter, new information is achieved through discovery. But in concept formation and most other common forms of thinking, information is reduced. For example, in forming the concept of roundness, we do not retain detailed information about the exact size and color of all the balls, plates, coins, globes, and other round objects we have ever seen. We *reduce* this information to the one feature all these objects have in common—their round shape. In studying for a final examination we strive to retain, not the whole huge mass of detailed information presented during the course, but the general principles illustrated by this information. These principles, while much smaller in volume than the total material read, will be much more useful. Even adding numbers is a form of information reduction—2 and 5 and 7 are no longer kept in mind individually when we have arrived at their sum, 14.

This approach to the study of concept formation may provide a means of measuring the difficulty of thinking in various kinds of situations. The question is whether tasks calling for differing amounts of information reduction show corresponding differences in difficulty, as indicated by time required to complete the task and/or number of errors made. A series of experiments has shown that difficulty does increase with amount of information reduction required.

In a typical experiment, tape recordings of fifty series of eight numbers between 1 and 64 were used. These numbers were presented to the subjects at rates of one number every four seconds, every two seconds, or every second. Subjects were asked to perform one of the following five tasks: (1) simply write down each number as they heard it; (2) add each successive pair of numbers and record the sum; (3) classify each number as high (above 32) or low (32 or below) and odd or even; (4) classify each number into "A" (high and odd, or low and even) or "B" (low and odd, or high and even); (5) add each number to the previous total, keeping a running sum. Thus information reduction increased from Task 1 to Task 5. Results showed that difficulty, as indicated by time required to perform the task and errors made, increased uniformly from Task 1 to Task 5. There was relatively little difference in per cent correct on the first four tasks when the information was presented at four-second intervals, although a good many more errors were made on Task 5. When the time interval was shorter, the tasks requiring greater information reduction showed a greater decline in performance, as shown in the graph. Similar results were obtained in further experimentation dealing specifically with concept formation and using patterns of dots rather than numbers as the subject matter (Posner, 1962).

These experiments represent only a small beginning of the complex task of measuring thought processes, but they are a step in the direction of quantitative treatment, which, as we have seen, is the goal of scientific study.

Whenever an individual finds himself in a novel situation in which he is motivated to achieve a certain goal but in which his progress toward the goal is blocked by some obstacle for which he has no ready-made response, he is confronted with a *problem*. Solution of the problem involves the development of some mode of response which will eliminate the obstacle. Since frustration is an inevitable

concomitant of living, a large part of an individual's behavior necessarily involves problem-solving activity.

Problem solving utilizes the products of previous learning experiences and is itself a learning experience. Higher mental processes may also be called into play. New concepts may be formed, deductive or inductive thinking—or both—may be required, and evaluative thinking

may come into play in the formulation and testing of hypotheses and in the acceptance or rejection of a given solution.

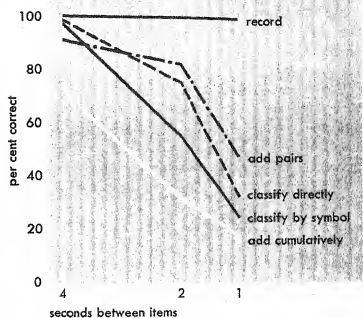
Trial and Error

Not all attempts to solve problems involve thinking. Where the problem is either so difficult that the subject "hasn't a clue" or involves arbitrary relationships that cannot be discovered by thought, the subject may engage in random trial-and-error behavior with no evidence of thinking. This seemed to be essentially the case in the earliest experiments in problem solving, which involved putting a hungry cat into a puzzle box. The problem was for the cat to learn to manipulate a latch which would open the door. During the first few trials the animal would display a great deal of varied activity, pushing his nose or paws between the slats in an effort to get at the food and biting and clawing at the slats. Eventually he would press the latch, and the door would open. The experimenter would record the amount of time the cat took to reach this solution and then put him back in the cage for another trial. On succeeding trials the escape time would slowly decrease as superfluous movements gradually dropped out, until after fifteen or twenty trials the cat would make the correct response immediately. Characteristically, such learning was irregular but showed a gradual course of improvement in which the extraneous responses were slowly eliminated.

Not all trial and error is random. Edison's trial of one substance after another in his attempt to find a filament for an incandescent light was not a random search. The careful testing of hypotheses that lies at the heart of the scientist's work is controlled, planned trial and error. Usually in our daily problems, too, we know enough about the situation to form plausible hypotheses, so that our behavior in solving them is a testing of possibilities rather than random trial and error.

Nor is all trial and error a matter of *overt* manipulation of physical objects. Some alternatives we can eliminate just by thinking about them—by manipulating symbols instead of objects. Often we can visualize what will happen

SPEED, COMPLEXITY, AND ACCURACY IN THINKING



Based on Posner, 1962

under given conditions and check this result against the requirements of our problem. This is called *covert* trial and error; it, too, may be random or carefully planned.

Insight

Sometimes in problem-solving experiments solutions come suddenly instead of gradually, and without observable trial and error. Often there is a period of no apparent progress, followed by sudden arrival at the solution.

In a famous series of experiments with apes, the animals were placed in problem situations where materials at hand, if properly employed, could be used in achieving a solution. The problems involved getting food by making the proper use of various materials placed in the cage. In one of these experiments a basket of fruit was suspended from the wire roof of the cage in such a manner that the basket could be made to swing back and forth when a string was pulled. At one point of the arc described by the swinging basket there was a scaffolding. Although the animal could not reach the basket from the ground, he could catch it as it swung if he jumped up on this scaffolding.

At the beginning of one set of observations the basket was set swinging and three apes, Chica, Grande, and Tercera, were let into the cage. Grande attempted to reach the basket by jumping—a routine response—but failed. Chica had in the meantime looked the situation over and suddenly jumped to the scaffolding to catch the basket as it swung past.

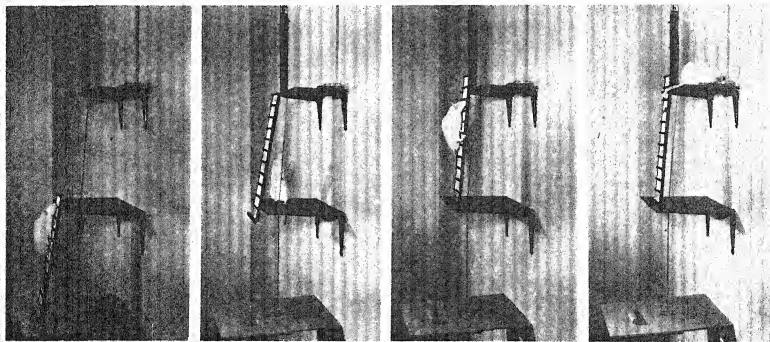
In other experiments the subjects suddenly used boxes or sticks in new ways to solve a particular problem such as reaching an object which was not immediately accessible. The interpretation put on this behavior was that the sudden solution was evidence of "insight," as opposed to random trial and error (Köhler, 1926).

The interpretation of these studies is difficult because it is not known whether the subjects had had previous experience with similar situations. We have already seen (p. 244) that monkeys can solve new problems on the first trial when they have had previous experience with similar problems. Even though the new problem has all new particulars, they can solve it on the basis of the common principle. Chica's sudden solution may have been the result either of such previous learning or of covert trial and error.

That monkeys are capable of manipulation of symbols has been shown in many studies.

Psychologists' first definition of insight, as sudden perception of relationships in the absence of trial and error, has proved misleading. Although suddenness may be a good sign of insight, understanding does not always come suddenly, and there is always the possibility that covert trial and error has taken place. Insight is better defined simply as *awareness of key relationships*. Such awareness, if it comes, may be sudden—or it may be gradual, coming only after the assembling of relevant information and either overt or covert testing of possibilities.

Human problem solving commonly involves a mixture of insight and trial and error. Usually we start out with more insight into a problem than was possible, for example, for the cats in puzzle boxes. This is true both because most of our problems are not totally unfamiliar to us and because there are likely to be intrinsic relationships in our situation, whereas the latch to be pressed in the puzzle box had no inherent relation to the food. So we make plausible hypotheses on the basis of what we already know



■ Animals have been found to be capable of mastering complex problem-solving situations. For example, the rat shown here has learned to pull up a wooden ladder on a chain pulley from one shelf to another to get food. He was given no help of any kind in solving the problem.

from experience and then test them, either through action or by thinking through the proposed solution. As we see the results of these tentative solutions, our insight increases, and our later hypotheses come closer to meeting the requirements for solution—until at last we “have it.” Seldom do we solve a problem without trying some alternative possibilities; and the final achievement of a solution implies, by definition, some insight into the important relationships. Even the cats in the puzzle boxes gave evidence of this in the end, by going straight to the latch. Indeed, their earlier attempts to bite through the slats or to reach between them were not completely random movements.

The occurrence of thinking in the solution of a problem seems to depend not only upon the inherent “thinking capacity” of the animal or individual involved but also upon the nature of the problem—that is, whether it involves relationships that the subject *can* discover through thought. In many of the instrumental learning studies in Chapter 6 the apparatus did not make possible anything but random trial and error; thus the animal’s ability for insightful learning was not revealed. Problems involving complex relationships have been successfully solved, however, by members of a great many species. ■

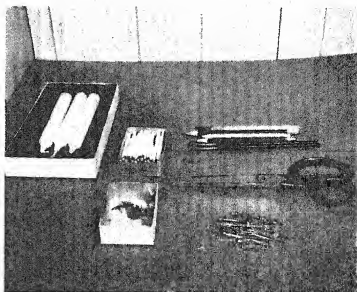
Studies of human problem solving have used problems of several types—mathematical problems, mechanical or “tool” problems, and practical problems and puzzles of various kinds. • All of these require some degree of thinking.

Steps in Problem Solving

There have been many attempts to describe reasoning, problem solving, and creative thinking in terms of steps or stages (Wallas, 1926; Dewey, 1933; Patrick, 1937; Vinacke, 1952; Cofer, 1957). The various formulations may be fused together into the following account:

1. *Becoming concerned about or interested in a problem.* The person who is completely unmotivated will not think. There must be some need, such as a recognition of the lack of some practical labor-saving device or a felt urge to create some esthetically satisfying piece of

● In one study of human problem solving, subjects were presented with objects like those shown here. The task was to mount the three candles vertically on the screen behind the table using only materials from among those on the table. Could you solve such a problem? Try to figure it out; if you are stumped, turn to page 356 for a further clue.



music. Clear recognition of just what is required may be an important step in the solution of a problem.

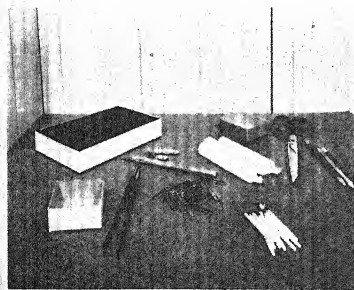
2. *Assembling the materials with which to work.* The problem-solving thinker must examine closely the situation with which he is concerned. Why are the machines now available inadequate, and what are the areas in which trouble most often appears? The creative artist goes through a similar period of preparation. Sometimes after a period of concentration on the requirements to be met, the inventor or artist will purposely turn his attention to something else. Such an interlude may serve as an “incubation” period, and when he returns to his problem he may find that new ideas have crystallized.

3. *Deriving a number of possible solutions.* While a person is thinking about the problem, working with the materials he has assembled, various possible ways of solving the problem may occur to him. Sometimes these solutions come so suddenly and so dramatically—so adequately—that the thinker is inclined to think of them as “inspirations” or “illuminations.” This seems to occur particularly with

artists, but the process is not really different from what has been reported by scientists who have been curious about their own thinking processes. It must be remembered that the technically trained worker (whether mathematician, poet, or musician) has put an enormous amount of time and effort into mastering the "tools of his trade"—into achieving an easy skill in all the subprocesses which would have to be performed most laboriously, if at all, by a novice in the field.

4. *Evaluating the suggested solutions.* Further data pertinent to the problem are recalled and used as a standard against which the hypothesis is checked. Frequently this procedure will be sufficient to justify discarding the first hypothesis. In this case another hypothesis is suggested from past experience with related problems, and it in turn is subjected to evaluation in terms of the known facts.

5. *Objectively testing and revising the solution.* If the known facts are not complete enough for evaluation of the hypothesis, new facts may be sought and new observations made. The new evidence may support the hypothesis, show it to be fallacious, or suggest ways in which it should be revised.



If you could not think of a way to mount the candles vertically on the screen behind the table in the problem presented on page 355, would it help to have the objects presented to you like this instead? If you still are stumped, turn to page 363.

In artistic work details often have to be changed in order to "iron out the rough spots." In scientific work and in everyday life, too, tentative solutions often must be subjected to careful tests before they are accepted for practical use. The layman sometimes is impatient because new medical discoveries are not immediately applied in practical medical work, but the research physician knows that hasty applications may have unforeseen ill effects.

The following description of an attempt to discover the reason for a certain kind of behavior in robins is an example of how these five fundamental steps are used in problem solving.

1. (*Problem*) Why does the robin cock his head to one side before pulling a worm out of the earth with his bill?

2. (*Data*) Observation of a large number of robins shows that they all behave in the same way, namely, cock their heads to one side before pulling out a worm. Observation shows that robins have eyes and ears, and that they eat, sleep, run, walk, fly, and do about all the things expected of birds.

3. (*Hypothesis*) Maybe the robin is listening for a worm.

4. (*Evaluation*) There is not much about a worm to make a noise, because his body is soft and he pushes the dirt around him quite slowly. Any sound made would be very low both in intensity and in pitch. It is unlikely that the robin could hear a worm.

3'. (*Hypothesis*) Maybe the robin is looking for a worm.

4'. (*Evaluation*) The robin, unlike the human being, has eyes at the sides of his head, and thus would find it necessary to turn his head to focus. Even though worms do not make much noise, they do cause tiny movements of the earth which could be seen. (This solution is judged to be satisfactory.)

5. (*Verification*) An experiment is conducted in which blind robins and deaf robins are observed and the conclusion is confirmed.

Actually, these processes are blended and interwoven in most problem solving. Often they occur together and tend to be phases rather than sequential steps. The processes of preparing and assembling materials may continue almost to the end, and those of formulating hypotheses, evaluating, testing, and revising may

gap. Look at the terminal words and then fill up the gap in any way that you think to be indicated." The words given were:

a, by,

horrible.

Practice on the number series appeared to be of little help, for only two of more than 200 subjects filled the gaps with words whose initial letters were in alphabetical order and whose number of letters increased by one. Five others met one of these two requirements, but the rest tried to make up sentences. When one more item of information was given, so that the series read:

a, by, cow,

horrible.

the subjects had a little more success in filling the gaps properly. A sample of the kind of word series which would fulfill the requirements is:

a, by, cow, drop, event, friend, Germans, horrible.

When a fourth word was provided at the beginning of the series, nearly all subjects were able to interpolate successfully.

Extrapolation, the second kind of gap-filling, is more difficult because the terminal point is not given. In one study of extrapolation the task was to extract a rule of structure from incomplete evidence given and then identify from a number of given items certain items which fulfilled the rule. Subjects were given a card on which the following group of words appeared:

a, gate, no, i, duty, in, cat, bo, ear,
o, travel, erase, both, get, ho, fate.

erase
fate

They were told to complete the vertical arrangement indicated by the words *erase* and *fate*, using words from the group listed above and taking *erase* as the middle word in the column. They were also told that not all the words given need be used. Only two out of 100 subjects were able to achieve the solution shown here:

a
bo
cat
duty
erase
fate
get
ho
i

As in the interpolation experiment, a few made an alphabetical list and a few systematically varied the number of letters in the words. Adding a third item of information by placing the word *duty* above *erase* made much less difference in performance than did the addition of a third item in the interpolation task. When they tried a similar but more complex task, the subjects who had succeeded in extracting at least one rule in the first task searched for rules again, while those who had merely made a random selection of items proceeded to use this method again and required a good many items of information to make them give up this tendency.

In the third kind of gap-filling, the stopping place is defined and the necessary items of information are also present but in disguised form so that they need to be reexamined from some special point of view and reinterpreted before they can be used. Much of the thinking we call *problem solving* falls into this category. Verbal tasks requiring the reinterpretation of items include anagrams, which may even be incorporated in sentences, as, for example, "Are we, lad, in the right state?" This was presented as a clue for a crossword puzzle. Most subjects arrived at the solution, *Delaware*, without being conscious of the steps they had followed in reaching it. Some said, "*Delaware* occurred 'in a flash.'" Others explained that the first three words, being rather unusual, suggested an anagram and *Delaware* was then immediately apparent.

In another item the clue was, "This capital sounds as if it were multiplying." Here most subjects needed to know how many letters the answer contained before being able to discover the word. Others required the first, last, and perhaps middle letters. Being told that the word contained five letters, began with *I* and ended with *H*, many decided it must be *Irish*,

but were likely to say, "But I can't see why." Often it was later, when they were doing something else, that they would suddenly remark, "Well, of course, the Irish capital is Dublin." Others, however, were satisfied with their solution even though they never made the connection with "dublin" and thus never fully understood the answer. The steps used by solvers appeared more clearly in this problem than in the Delaware anagram.

In solving problems such as this, the first step is recognizing the nature of the problem—an anagram requires a different mode of attack than a code or cipher. Also, it is evident that information already stored is called upon to aid in reaching a solution.

Structures

A recent approach to the study of problem solving regards it as essentially a process of thinking in *structures*. Whether by random trial and error or by insight into his problem, the individual must somehow arrange the elements of the situation he faces into an orderly pattern of relationships. Such sets of relationships and/or interdependencies between events are known as *structures* or *models*; they enable us to predict what will happen in the future.

In an experiment designed to investigate how structures or models are built up, subjects attempted to discover the rule structure of a very simple card "game." The subject faced the experimenter at a table on which there was an upright screen with a window in it through which a card could be displayed. The experimenter gave the subject two cards, each with a different symbol on it, and explained that he also had two cards exactly like those held by the subject. The experimenter would display one of his cards in the window. Then the subject was asked to "play" one of his cards by showing it, after which the experimenter would close the window and reopen it, to display either the same card or the other one. Which of the two he displayed depended entirely upon what card was in the window before and what card the subject played. The subject's task was to discover the rules which governed the appearance of the cards. Did card A followed by his playing of card B result in the showing of card A again? Or of card B? What happened if he played card A? And so on, until he

had the rule structure in mind. After four preliminary trials, he was given prediction trials, in which he was asked to look at the window, play a card, and state which card he expected to see in the window next. After he appeared to be able to predict the cards accurately, he was asked a number of specific questions about the operation of the game. He was also asked how he had arrived at the rules.

Analysis of answers to these questions revealed that, like subjects discovering the common element among several possibilities (p. 350), these subjects also employed various "strategies," depending upon their evaluation of the nature of the task. Those with the "operator evaluation" considered the card they played as influencing the card in the window, one card usually keeping the window card the same and the other usually producing a change. Their strategy consisted primarily of playing the same card repeatedly to establish what would happen. On the other hand, those with a "pattern evaluation" of the task regarded the game as having two possible patterns—one, when the card in the window and the card played had the same symbol; and the other, when the cards had different symbols. These subjects used the strategy of testing a consistent pattern or combination of plays. In the third evaluation, memory, the subject simply tried to remember the possible combinations of cards and the results of each. The operator or partial operator strategy produced the best results in terms of fewer errors and smaller number of trials required to learn the rules. The pattern strategy was next most successful and the memory strategy least successful. These differences in success of the strategies were more pronounced when more complex games involving four elements were used (Jeeves and Dienes, 1965).

Decision Making

Decision making is not a simple process. Each decision leads to many others which are dependent upon the first one. For example, a decision to major in psychology rather than in history is a beginning, not an end of decision making. Numerous other decisions—which area of psychology to specialize in, which courses to take, ultimately what kind of position to look for—grow out of the original decision to choose psychology as a major. Furthermore, many of the factors upon which the decision must be based are uncertain—whether you will continue

to enjoy psychology, how well work in that field will pay by the time you graduate, and so on. The special kind of problem solving involved in such decisions as the choice of a college major is *decision making* as we shall consider it in this section. It is, of course, much more complex than the solving of problems such as the question of why the robin cocks his head when seeking a worm.

Probability and desirability in decision making. Let us take as an example one relatively simple decision described by three psychologists who have devoted a great deal of study to the process of decision making (Edwards, Lindman, and Phillips, 1965). Suppose you are faced with the problem of how to spend Sunday afternoon. It is hard to decide whether to play golf or go sailing because the weather that morning is uncertain. A mild wind is blowing, but the sky is overcast and there is some possibility of rain. If the sky clears and the wind does not die down, sailing will be very pleasant. However, the wind would interfere with your success at golf. On the other hand, if it should rain while you were golfing you could make a dash for the clubhouse, whereas you would be very uncomfortable in the open sailboat, especially if you were becalmed and could not reach shore for quite some time. Since the forecast was for sunshine all day, the weather report is of no help.

Five elements will be involved in your decision: (1) the possible actions—golfing or sailing; (2) the possible states of the world—rainy or sunny, windy or calm; (3) your opinion of the probability of each state; (4) the outcome to be expected from each possible combination of actions and states; and (5) the positive or negative value to you of each outcome. It is quite possible to work out systematic ways of representing all these elements, assigning mathematical values to them, and figuring mathematically which choice would be best, given your estimates of probability and your determination of values. But a decision of this nature, even though based on mathematical computations, would still be ultimately derived from subjective and evaluative thinking in the assignment of values and the estimating of probabilities.

Bias in decision making. That subjective factors operate in decision making even where one is supposedly dealing with established probabilities rather than preferences is evident from studies of predictions of coin tossing and dice throwing, where the chances of a given result are known.

In one study, subjects were found to show bias in that they expected either heads or tails to come up more frequently; they also tended to be biased in favor of certain combinations when rolling a die. Only when special dice were used, with the nonsense syllable ZOJ on three faces and ZEJ on the other three, did subjects consider the probability of turning up ZOJ exactly equal to that of turning up ZEJ (Davidson, Suppes, and Siegel, 1957).

Cognitive dissonance. Bias in spite of definite knowledge of probability can sometimes be explained in the light of a principle which has come into prominence in recent years—*cognitive dissonance*. We have seen how our perceptions tend to clarify ambiguous stimuli in such a way as to make our environment harmonious and stable. In the same way, cognitions that are unbalanced or incongruous (dissonant) tend to become more congruous, better balanced, less dissonant. As an example, knowing that you had worked hard to prepare for a future event would be dissonant with the belief that the event would not occur. In such a case the dissonance might be reduced in any of three ways: (1) by persuading yourself that you really had not worked very hard after all; (2) by finding some other future goal to justify your effort; or (3) by persuading yourself that the expected future event is in fact likely to occur after all.

This last means of reducing dissonance was studied in an experiment using as subjects sixty high-school girls who had volunteered to participate in an experiment on "techniques of studying."

Each subject was asked to make a two-hour appointment but was told that only half of the volunteers would have to stay for two hours, while the other half would be able to leave at the end of one hour. At the time she arrived, each girl was told that 50 per cent of the subjects would be asked to take a new kind of IQ test that would measure how well they were able to

use certain specific information that they were to be given during the first hour. Those who were to take the test would be notified at the end of that hour. "High preparatory effort" subjects were told to memorize the definitions on the "information sheet," because if they should be asked to take the test they would need to know the material thoroughly and they would not be allowed to use the sheet during the test. "Low preparatory effort" subjects were asked to look over the information sheet briefly so as to be familiar with it but were told that they could have it with them during the test if they took it. After each subject had finished with the information sheet, she completed a brief questionnaire and was then told the true nature of the experiment. No intelligence test was actually administered to anyone.

The questionnaire included a six-point scale ranging from "very easy" (-3) to "very difficult" (+3) on which students were asked to indicate the difficulty of the preparation they had done. The mean rating given by the high-effort subjects was +.7, as compared to -.9 for the low preparatory subjects, showing that the high-effort subjects really felt they had worked hard. The questionnaire also included the question: "Do you believe that you are one of the people that have been selected to take the test?" A six-point scale ranged from "certain" (+3) to "definitely not" (-3). While 92 per cent of the high-effort subjects checked the plus side of the scale, only 60 per cent of the low-effort ones did so. Thus the results definitely supported the hypothesis that expending effort in preparation for an event increases the belief that the event will occur, even when the probability is known to be fifty-fifty. As a control measure, other questions were included, concerning how important subjects thought IQ measures were, how difficult they expected the IQ test to be, and how anxious they felt about possibly having to take the test. On all these questions the mean ratings were very close together for the two groups (Yaryan and Festinger, 1961).

Some studies of cognitive dissonance have been criticized on the basis of faulty design or faulty analysis of results and especially for trying to deal with social events which are so complex that all relevant variables cannot be controlled (Chapanis and Chapanis, 1964).

For example, one study of cognitive dissonance dealt with the opinions of smokers and nonsmokers about the linkage between cigarette smoking and lung cancer. According to the results, only 7 per cent of heavy smokers believed that the linkage was proved, as compared

to 29 per cent of nonsmokers, whereas 86 per cent of heavy smokers believed it was not proved, as compared to 55 per cent of nonsmokers. (The rest stated they had no opinion.) Light and moderate smokers fell between these two groups in their opinions, as would be expected (Festinger, 1957). The results of this study could be taken as evidence supporting the hypothesis that people who smoke tend to reduce cognitive dissonance by persuading themselves that smoking is not harmful. The situation is not quite so simple, however. Such an explanation ignores the individuals' reasons for choosing to smoke or not to smoke in the first place. For example, many people may refrain from smoking because they believe that cigarettes are harmful. If so, this initial difference could explain the difference found later.

In spite of such criticisms, however, cognitive dissonance appears to be a concept worthy of further study under well-controlled conditions such as those maintained in the Yaryan and Festinger study cited above.

Individual Factors in Problem Solving

Success in any particular problem-solving situation depends on many factors. All thinking takes place within a context which includes the thinker's motives, attitudes, and memories of past experience, as well as his particular "set" at the moment (Johnson, 1955). Thus thinking—like perceiving and learning—is always to some extent personalized: each person's particular background of motives, experience, and beliefs gives him a unique framework within which his thinking takes place.

Mental set. The situation we are in at any particular moment gives us a "set" which renders some perceptions and thoughts more likely than others. Numerous experiments with reaction time, perception, learning, recall, and problem solving have shown the importance of this set in determining response. For instance, if the subject is set to work for speed, his accuracy may suffer (May *et al.*, 1957). If the experimenter instructs his subjects to cancel out all the O's in a stanza of poetry, the subjects may not notice what the poem is about; or, if he

▲ A farmer brought a blacksmith 5 bits of chain, each having 3 links, and asked to have them welded into a single length of chain with 15 links.

The blacksmith said the charge would be 5¢ per cut and 25¢ per weld. The farmer gave him \$1.20, but the blacksmith said, "I don't want to cheat you; the price is 90¢."

How did the blacksmith do the job for 90¢? Check your solution with the one given on page 364.



tells them to memorize the poem, they probably will not notice such other things as whether the page arrangement is artistic or whether there are more O's than A's in the lines. In other words, what we perceive, learn, or think is greatly influenced by what we are set for. Such processes of selection and regulation are always going on, even though we may be unaware of them. ▲

A mental set may either help or hinder us, depending on whether it directs us toward a desired goal or makes us "blind" to the key elements of a situation. If you approached the problem above with the customary set, thinking in terms of joining each short chain to the next one, you probably had trouble solving it. Many problems both in the laboratory and in everyday life seem temporarily insoluble if we approach them with an inappropriate set.

Rigidity. One way in which set can hinder problem solving is through a rigid continuation of behavior which has been successful previously but which for some reason is inappropriate to the present situation.

This type of hindrance in problem solving was illustrated in a study conducted on 2709 subjects, including students in high schools, colleges, and adult education courses. Subjects were asked to solve a series of problems dealing with the measurement of water, such as: "Given three jars—A holding 21 units, B holding 127, and C holding 3—how would you get 100 units of water?" The solution would be: "Jar B minus Jar A minus Jar C gives the required amount."

After working a simple introductory problem, the experimental subjects all worked five "set-producing" problems for which the same formula gave the answer. Then they were asked to solve two "crucial" problems which could be solved either by this formula or more simply by the use of only two jars. A problem which could be solved only by the use of two jars, followed by two more "crucial" ones, completed the series. A control group solved only the introductory problem and one of the "set-producing" problems before tackling the rest of the list. Half of the experimental group were told, "Don't be blind," and asked to write these words at the top of their papers as a reminder.

In half of the classes over 75 per cent of the plain experimental subjects solved the crucial problems by the longer, set-produced method. In every class at least half of the subjects did so. On the problem which could be solved only by use of two jars, 50 to 90 per cent failed to find a solution. The "Don't be blind" group had considerably better success on this problem and showed fewer "set" responses to the two problems following it, although about 50 per cent of them had followed the set formula on the first two crucial problems. The control groups solved the crucial problems by the simpler method in all but a few cases (Luchins, 1942).¹

Such hindrance may be only a matter of the particular set established just prior to the critical problem, as in this water-jar experiment. Or long-term habitual ways of behaving may keep us from seeing new possibilities. We may be familiar with all the elements needed for a new solution but be unable to organize them in new ways. This helps explain why an "outsider" can sometimes suggest solutions that have not occurred to those closely involved with a problem.

Functional fixedness. Another way in which set may hinder problem solving is through functional fixedness—inability to see a new use for a familiar tool.

To demonstrate this phenomenon, subjects were presented with a variety of problems, including the candle problem posed on page 355. The solution for this task is shown in the photograph. ■ A second problem required the subjects to suspend three cords from a board. Among the objects presented were two

1. Although the water-jar problems have been useful in demonstrating the effect of various conditions in creating a temporary set toward mechanization, factor analytic studies have shown that they do not give valid measures of a generalized trait of rigidity (Frick, Guilford, Christensen, and Merrifield, 1959; Levitt and Zuckerman, 1959).

screw hooks and a gimlet from which the cords had to be hung.

With each problem, one of the objects necessary to the solution was given a prior use for the experimental group. In the first problem, for example, the candles, matches, and tacks were presented to the experimental group in the manner shown on page 355, so that the boxes were first perceived as containers instead of as potential resources to be used. For the control group, the candles, matches, and tacks were presented in the manner shown on page 356. In the second problem the experimental group first saw the gimlet being used to start the screw holes, which were already bored for the control group.

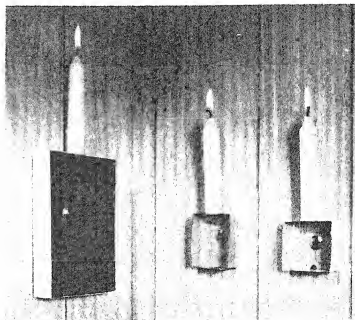
Solutions to the problems were found almost twice as easily when the necessary objects had not previously been given a different use (Duncker, 1945). These findings were later confirmed by another psychologist (Adamson, 1952).

Past experience. Often we are able to use concepts and generalizations formed in past situations that had certain similarities to the present one. Some "new" problems, in fact, can be solved entirely by the application of past learning. Others require that we work out new concepts or discriminations.

In general, the greater an individual's relevant experience in a given field, the more concepts and generalizations he will have as potential tools for solving new problems in that field. Thus we expect a mathematician to solve mathematical problems more easily than a non-mathematician and an architect to do better than someone without architectural training in solving an architectural problem. Without relevant past experience, we may not even be able to understand the problem to be solved. Thus, except in instances such as those described above, where past experience blinds an individual to the requirements of a new situation, it is likely to play a major role in the solution of problems.

Personal context. The influence of the individual's personal context on his problem solving is shown in a recent study comparing the responses of men and women to problems appropriate to the masculine or feminine role. In our culture the need to conform to one's sex role is commonly very strong.

■ Here is the solution to the problem of the candles. Replications of the study have confirmed the original finding that the problem is more difficult when the objects are presented in the boxes, as you saw them first, fostering the perception of the boxes as containers instead of as possible materials to use in solving the problem. The problem is also made more difficult when extra, unnecessary objects are presented, as was the case here.



The subjects, twenty-four undergraduate men and twenty-five undergraduate women, were given a set of twenty problems, half with content appropriate to the masculine role and the other half with content appropriate to the feminine role. Clear sex differences were found. When the problems were altered so as to make them less appropriate to the one role or the other, sex differences in problem solving were reduced (Milton, 1959).

The relationship between ability to solve problems and a general tendency toward conformity has also been studied.

A study employing sixty-four male and seventy-seven female psychology students as subjects compared their achievement on two types of problems—straightforward and restructuring—with scores obtained on a conformity test. The straightforward problems were workable by direct methods; the restructuring problems were such that the subject's first approach was incorrect and a change was necessary before the problem could be

solved. The restructuring score was used as a measure of flexibility.

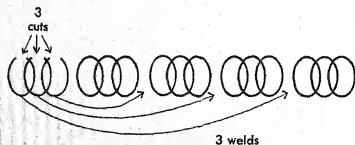
As a conformity test, the subjects were asked to tell which of two forms, a circle and a star, was the larger; the circle was really half again as large as the star. Each subject was in an isolated booth in which there was an electrical response board supposedly showing the responses being made by other subjects. Actually this was controlled by the experimenter and could be made to show inaccurate judgments.

The results showed a negative correlation between achievement in problem solving and a tendency to conform; that is, those who did most poorly in problem solving showed greater conformity in their size discrimination answers. Despite the fact that the restructuring problems required greater flexibility, the correlation was approximately the same for both types of problems. Nor were sex differences in problem-solving ability found to be associated with sex differences in conformity (Nakamura, 1958).

We have all seen people become so emotionally involved in the defense of a controversial position that they seem blind to logical arguments on the other side. This phenomenon may be investigated in laboratory studies by asking the subjects to indicate the validity of syllogisms.

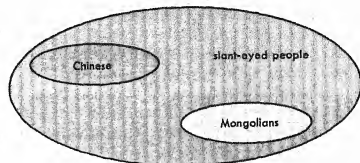
The following is an example of a syllogism which, although the conclusion happens to be true, is not valid:

All Mongolians are slant-eyed.
The Chinese are slant-eyed.
Therefore, the Chinese are Mongolians.



The blacksmith cut all 3 links of one piece of chain (15¢), and used them to join the remaining 4 pieces (75¢).

The conclusion does not follow from the two premises, as can be seen in the graphic representation below.



The area within the large ellipse represents slant-eyed people; the area in one of the small ellipses represents Mongolians and falls within the large one. The other small ellipse (Chinese) must also fall within the large one, which contains all slant-eyed people, but may or may not overlap Mongolians. Notice that the conditions stated in the syllogism would be satisfied in either of these cases; thus the conclusion is not valid.

In one study, subjects had to judge the validity of forty syllogisms, half of which dealt with socially controversial material and half of which had neutral content. Each controversial syllogism was paired with a neutral one as to form, logical validity, and approximate number of words, but the neutral and the emotionally toned syllogisms were presented in different order to different subjects. The subjects were also asked to state whether they agreed or disagreed with the conclusion of each of the syllogisms.

Most subjects judged the neutral syllogisms more correctly than the emotionally toned ones. Previous knowledge of the truth or falsity of the conclusions of the neutral syllogisms influenced the subjects' reasoning in the direction of their knowledge, and their attitudes and beliefs about the emotionally toned syllogisms tended to influence their reasoning in the direction of their convictions. The subjects who judged all the controversial syllogisms first did most poorly on the neutral ones, whereas the subjects who judged the neutral ones first did better than the other subjects on the emotionally toned ones (Lefford, 1946).

This experiment shows that emotional subject matter can affect logical reasoning not only in the immediate problem but also in those which follow it.

Frustration and stress. We have already noted (Chapter 7) the adverse effect of frustration and other stress on learning. The effect of stress on problem solving has been the subject of a number of studies. One method has been to induce frustration in one task and note its effect both on that task and on tasks following.

In one study a group of psychology students in India were given a problem-solving test and divided into two groups equated on the basis of their scores. Four months later they participated in the second part of the experiment. While the members of the control group were given an irrelevant task, the members of the experimental group were frustrated by being given a block-tapping test so difficult that success was impossible. The experimenter then showed them false norms and expressed concern about their failure. Following this experience the problem-solving test was repeated.

Both groups gained significantly over their original performance, but their behavior was quite different on different parts of the test. The problems were of increasing difficulty, and at the beginning the frustrated group showed a greater gain than the controls, apparently being highly motivated to succeed this time after having "failed" on the block-tapping test. But at the point where the problems became much harder, the frustrated group fell off sharply in their performance, while the controls continued to improve steadily. Subjects who had shown the most frustration in the block-tapping test did most poorly on the difficult problems (Mohsin, 1954).

Stress is more of a hindrance to problem solving when the solution requires a complex response that goes against old habits of thought and action than when simple, isolated judgments are required and previous experience is directly applicable (Reynolds, 1960). It has also been found that when people do not feel they must defend themselves from threat, they show much greater flexibility in exploring new solutions (Cowen, 1952).

Freeing thought from rigid patterns. Fortunately, there seem to be ways of overcoming or lessening the tendency toward rigidity and functional fixedness in approaching new problems.

One way is to introduce a time lapse. For example, as we saw in Chapter 7, the set estab-

lished in problems of the water-jar type is somewhat overcome when the subject has ample rest between problems.

A time lapse may also reduce functional fixedness.

In an earlier study testing the effect of ample time on functional fixedness, investigators asked students to construct an electric circuit from a drawing. Half of them had to use a small relay in their construction, whereas the other half used a microswitch. Later they were given the problem of tying together two strings which hung from the ceiling and which were too far apart to be reached by the subject at the same time. The solution was to hang a small weight to one string and swing it like a pendulum so that it would swing close to the other string and could then be reached. A switch and a relay were the objects available for use as weights. A previous experiment had shown that subjects who had used the relay in the electric problem nearly always chose the switch as a weight, and vice versa, indicating functional fixedness (Birch and Robinowitz, 1951).

In the later study, various intervals—a minute, half an hour, an hour, a day, and a week—were allowed to elapse between the two problems. After a minute or half an hour, 70 per cent used the object not previously used in the earlier problem; after an hour, 65 per cent; after a day, 53 per cent; and after a week, 50 per cent. Thus functional fixedness decreased with time (Adamson and Taylor, 1954).

One investigator reasoned that since problem solving by its very nature requires an uncommon response, practice in making uncommon responses would aid subjects in solving later problems, even though the solutions were unrelated to any of the responses used in the earlier practice.

As a warm-up, subjects were asked to write down as many uses as they could think of for a number of common objects, after which they were given a problem which involved a screwdriver, a piece of balsa wood, and two strings hanging several feet apart, as in the preceding study. The problem was to get hold of the two strings, one in each hand, without breaking or detaching them.

The solution was to tie the screwdriver to one string, set it swinging, seize the other string, and then catch the first string as it swung within reach. The subjects who had taken the warm-up test solved the problem signifi-

cently faster than did a control group (Maltzman, Brooks, Bogartz, and Summers, 1958).

Eight rules have been suggested to aid in preventing the kind of rigidity in thinking which leads to failure in solving problems for which all the necessary information is at hand (Hyman and Anderson, 1965). These are:

1. *Run over the elements of the problem in rapid succession several times, until a pattern emerges which encompasses all these elements simultaneously.* This is important in view of the fact that, as we saw on page 225, the memory span encompasses only about seven items. Since the problem may contain more than seven elements, you should make certain that none is overlooked or forgotten.

2. *Suspend judgment. Don't jump to conclusions.* If you hastily formulate an inadequate solution, it is difficult to discard or even to revise it. Thus it may interfere with the finding of a good solution. The value of this principle of deferment of judgment has been experimentally confirmed in several studies in which significantly more high quality solutions (scored on uniqueness and usefulness) have been produced under instructions to defer judgment than under instructions to follow conventional thinking procedures (Parnes and Harding, 1962).

These first two rules are preventive in nature and may be summed up in the adage, "Look before you leap." The next rules tell what to do after you have leaped too soon or find yourself bogged down in a poor solution.

3. *Explore the environment. Vary the temporal and spatial arrangement of the materials.* You may thus keep your mind flexible and uncover familiar patterns which were masked by the original unfamiliar arrangement of the elements. New connections between elements will be discovered as the materials are arranged in different ways. You may have to find an altogether new approach, perhaps by finding a new difficulty to tackle. Once the second difficulty is eliminated, you may find that the first one is now easy to overcome. Only the poor reasoner persists doggedly in one direction—the good reasoner jumps from one direction to another till he finds a solution.

4. *Produce a second solution after the first.* While finding your first answer to a problem

you feel pressed to come up with a solution—you are solution oriented. Having reached at least one possible solution, you become problem oriented. That is, you turn the problem over in your mind and look at it from all sides in a more leisurely manner. Thus you can often come up with a more creative solution the second time. When pushed to the limit you may find a still better solution.

For example, a group of people were given relevant statistics and information about the declining teacher-student ratio in higher education and asked to write down a possible solution to the problem. Then, after an interval during which they performed other tasks, they were asked for a second solution. Finally, after another interval, they were pushed to the limit by being asked for a third solution while being blocked from using familiar ideas. That is, they were given a list containing their own first two solutions and several of the most commonly offered solutions and told that what was wanted were solutions that did not make use of any of these ideas. While about one fourth of them threw up their hands in despair, one fourth of those who tried found truly outstanding, creative answers to the problem. All who refused to give up managed to come up with a third solution which could at least be considered adequate.

5. *Critically evaluate your own ideas. Constructively evaluate those of others.* This precept was tested with a group of thirty-six engineers who were individually asked to solve an automatic warehousing problem. Before being asked for their own solution, half of them were given a set of solutions which other engineers had suggested and asked to list reasons why these would not work. The other half were shown the same solutions but asked to list as many strong points as possible in the previous solutions. The latter group came up with significantly more creative solutions than the group who had been asked to criticize the solutions of others.

6. *When stuck, change your representational system. If a concrete representation isn't working, try an abstract one, and vice versa.* For example, if you have been dealing with a problem in verbal terms, it may help to switch to a graph or a model or to numbers.

7. *Take a break when you are stuck.* But be sure you are really stuck. If your plan of attack is inappropriate or your perception of the materials is inadequate, a break is not likely to help you. But if you have thoroughly explored all the possibilities, a break will enable you to return to the problem refreshed and you may then be able to see a different approach.

8. *Talk about your problem with someone.* This forces you to consider aspects of the problem which you might not otherwise notice. You cannot take anything for granted but must fill in all the gaps in explaining the problem to someone else. Also, he may provide feedback by pointing out inconsistencies and obscure points in your thinking.

CREATIVITY

Creativity is usually thought of as pertaining to the arts. Actually, originality, or creativity, can occur in any kind of activity. Those who show originality and ability to integrate the elements of a situation into a harmonious whole—whether as a parent, a doctor, or a football player—are leading creative lives. They are able to project their unique personalities as determined by their genes and their culture into the development of a novel and useful effect, event, concept, or theory.

We have already seen that creative thinking is likely to involve inductive thinking. It also means a general freedom from rigid thought patterns and an ability to keep looking at situations in fresh ways. To be effective, however, creative people must also be able to use evaluative thinking at the proper time: to criticize their ideas, make revisions, and polish up the final product. A free-roving imagination is essential for obtaining the original idea, but systematic testing and evaluating of the idea is required to shape it into final form.

Characteristics of Creative People

What is the creative individual like? This is no mere academic question today, when it is so important that the fullest use be made of the creativity available in our population. Psychologists recently have been giving a great deal of study to the personality characteristics of crea-

tive individuals of various ages to find out what traits seem to be associated with creativity.

Persons with high intelligence may be very creative, but they also may not be, if they tend to be critical and analytical. Some brilliant people attack new ideas so vigorously and skillfully that they analyze them away and never advance beyond existing traditions. Thus in singling out "gifted children" for special attention it is not wise to go by IQ alone.

In one study of high-school students the highly creative ones, although 23 points lower in average IQ than the high intelligence group (highest 20 per cent of the class), were equal to them in achievement. However, teachers rated the high IQ group as more enjoyable to have in class than the high creativity group.

As compared to the high creativity group, the high IQ students showed greater agreement between the qualities they wanted for themselves and those they believed led to adult success and also between the qualities they wanted and those they believed their teachers favored. A striking difference between the two groups was that the creative group ranked "sense of humor" second among desirable traits, whereas the high IQ group ranked it at the bottom of the list (Getzels and Jackson, 1958).

A replication of this research on various groups of subjects found similar low correlations between IQ and creativity not only for high-school students but also for elementary school students, graduate students, and counselors attending a summer guidance institute (Torrance, 1960). However, highly creative students from

these groups were higher in scholastic achievement than were those low in creativity (Torrance, Yamamoto, Schenetzki, Palamutlu, and Baldora, 1960). This was also found to be true of junior-college students (Gumeson, 1963).

Another study of high-school students refutes the popular notion of the creative student as a "lone wolf." Very creative boys and girls were found to be higher on sociability measures than were noncreative ones (Green, 1957). As would be expected, highly creative junior-college students are higher in aesthetic values (see p. 146) than are those who are less creative (Gumeson, 1963).

Can Creativity Be Improved by Training?

In view of the present need for creative scientists, much attention has been given to the problem of developing creativity through training. A number of encouraging results have been reported.

You will recall (p. 365) that problem solving was facilitated by a "warm-up" in which the subjects listed unusual uses for common objects. The same investigators have conducted studies on the effects of training subjects to make uncommon responses or associations.

In one of these studies two experimental groups and a control group were asked to make free associations to a list of words. The experimental groups, one of which was frequently praised for original responses, were then given practice in thinking of additional associations for the words, and then all three groups were asked to give associations to a new list. Half of the subjects in each group were asked specifically to be as original as possible in performing this final task.

Instructions to be original on the final list produced significant increases in originality in all three groups, but more for the experimental groups than for the control group. Among those who were not instructed to be original, only the experimental subjects who had earlier been praised for originality were significantly superior to the controls, although the subjects who had had additional practice but no praise were also somewhat superior (Maltzman, Bogartz, and Breger, 1958).

Another study showed that having subjects make a number of different responses to the same word list was

more effective in increasing originality than having them make fewer responses to several different lists (Maltzman, Bogartz, and Simon, 1958).

These and other tests in the series led to the general conclusion that "originality is a form of learned behavior following the same principles as other forms of operant behavior" (Maltzman, Simon, Raskin, and Licht, 1959). This conclusion is confirmed by studies made at the Creative Education Foundation.

One of these compared experimental subjects to a matched control group on ten tests given before and after the experimental group had taken a course in creative problem solving. At the end of the course, the experimental subjects were superior to the controls on two measures of quantity of ideas and on three out of five measures of quality of ideas. Interestingly, they also showed significant increases in the personality trait of dominance (Meadow and Parnes, 1959).

A follow-up study showed that students who had taken the creative problem-solving course from eight months to four years previously did better on all the measures of creativity than a control group who had registered for the course but had not taken it (Parnes and Meadow, 1960).

A former advertising agency executive has developed and used widely a technique of individual or group "brainstorming" for ideas in which imagination is increased by a division of the process into two stages. In the first, or "green light" stage, the individual or group is presented with a problem or question and encouraged to try to be free of all inhibition and entirely uncritical. Each one is to try to think of anything at all related to the problem whether it seems practical or not. All the hypotheses are written down, even the most "far-fetched" ones. If several people are working together, no member may criticize another person's idea at this stage; when people are free from the fear of being shown wrong or ridiculous, they produce novel ideas much more readily.

In the second, or "red light" stage, the individual or group becomes judicial and considers each hypothesis carefully, retaining all those that have a remote possibility of being useful. These are then considered further, and eventually the more promising ones are tried out

(Osborn, 1957). This procedure can be carried out by an individual working alone or by persons working in groups. Research on whether this method actually increases creativity has had conflicting results. The specific experimental question of whether group "brainstorm-

ing" is superior to individual effort will be examined in Chapter 15.

As further research is done in the area of developing creativity, it may be possible, by systematic training, to increase the number of highly creative workers in our society.

INFORMATION THEORY

We use symbols not only in thinking but also in communicating our ideas to other people. *Information theory*, not actually a theory so much as a field of study, is concerned with the principles that make for understanding, control, and predictability in communication.

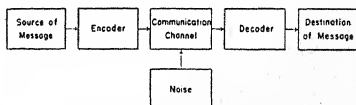
Many "systems" of communication exist. Some of these are very simple, some very complex. Some involve only people; some involve people and machines; others involve only machines. When information passes between two persons, an object and a person (a recording machine and a stenographer, for example), or an object and an object (the keyboard and the paper in a typewriter), communication has taken place.

The passing of information can be immediate (as when a boss dictates to a stenographer) or delayed (as when he dictates material to a tape recorder for later transcription). When we pass information to a friend by word of mouth, we employ a vocal communication system; when we send a letter, we use a written communication system. Often there are a number of subsystems through which the information must pass before it reaches its final destination.

Parts of a Communication System

All communication systems are made up of five basic parts: source, transmitter, channel, receiver, and destination (Shannon, 1948). Communication involves the transfer of infor-

mation, in the form of energy, between two separate points—a *source* and a *destination*—within an interval of time. The link which connects source and destination and supports the passage of information energy between them is the communication *channel*; it may be a telephone wire, a piece of paper, or simply air. The operation of converting information into transmittable energy—for example, converting ideas into speech sounds—is called *encoding*, and the message as it passes over the channel is called the *coded signal*. Encoding is performed by the *transmitter*, which in the case of spoken communication would be the human voice mechanism. When the coded signal has passed over the channel, it is decoded by the *receiver* so as to be usable at its destination. All communications, whether by vocal speech, gestures, or written symbols, or by mechanical, electronic, or other signals, can be analyzed into these basic five steps, diagrammed below.



Signals and Noise

In any communication system there are signals and noise. *Signals* are the planned events that carry information. An example is the code

used in telegraphic communication. Noise consists of unplanned and unwanted events which, occurring sufficiently often, can interfere with communication. Static in radio is a good example of what is meant by noise. In information theory, however, the term does not refer only to sound waves. Any random events that carry no meaning can be called noise.

Information can best be defined as a reduction in uncertainty. Experts in the field of information theory have coined a term for the unit of information by contraction of the words *binary* and *digit* into the one word *bit*. A bit is the amount of information which, when put into a system, reduces the number of alternatives by half—that is, eliminates 50 per cent of the uncertainty.

Let us take an example. I have in mind one of the letters A B C D E F G H. You want to find out which letter it is by asking me the fewest questions possible. I must answer your questions truthfully “yes” or “no.” Can you find a way to determine the correct letter by asking me not eight but three questions? If not, turn to the note on page 372. The following table shows the number of bits of information required to reduce the number of alternatives to the one right one.

Alternatives	Bits
2	1
8	3
16	4
32	5
1024	10
1,048,576	20

The power of this information system is seen in the fact that more than a million alternatives can be narrowed down to one certainty by the asking of twenty questions.

Before leaving the subject of information theory a distinction must be made between the technical concept of information and that of meaning. The words *a good man* could be encoded, transmitted, and decoded without noise (error) but have different meanings to different persons or in different contexts to the same person. To one it could mean “a moral man” but to another it might mean “a competent man.”

The greatest relevance of information theory to psychology lies in the clues it gives us as to

the manner in which information may be encoded and decoded in our nervous systems.

Feedback in Communication

It is often assumed—in the classroom, office, and shop, as well as in the lecture hall or the radio station—that the transmission of information from one person to another is a one-way proposition. Actually, however, communication cannot be entirely effective unless the individual doing the communicating is aware of the other person's reaction. If A is to transmit information efficiently to B, he must know whether B is receiving and understanding the information. In other words, there must be feedback from B to A.

In a study designed to test the effects of different degrees of feedback, instructors worked with individual students under four conditions: (1) zero feedback, in which the instructor was completely separated from the student; (2) the visible audience situation, in which students were visible to the instructor but could not speak to him; (3) a yes-no condition, in which students could reply “yes” or “no” to questions from the instructor; and (4) free feedback, in which students could ask questions or interrupt whenever they wished.

The instructors described abstract geometric patterns to the students, who were to reproduce the patterns from the descriptions. Accuracy of the reproductions steadily increased from zero feedback to free feedback conditions. However, the time required also increased. Therefore, a further experiment was conducted, using only zero and free feedback situations, over a longer series of trials. Under free feedback, the accuracy level was high on the first trial and stayed high. Under zero feedback, accuracy improved a great deal on successive trials, but it never reached the level which was achieved on the very first trial under free feedback. The amount of time required for instruction under zero feedback remained about the same, whereas under free feedback it decreased with successive trials. Free feedback, however, continued to require more time than zero feedback. Another interesting outcome was that free feedback generated confidence on the part of the students, whereas conditions of zero feedback tended to generate hostility (Leavitt and Mueller, 1951).

CHAPTER SUMMARY

Thinking involves the manipulation or organization of elements of the environment by means of symbols rather than overt activity. The two principal kinds of thinking are *autistic*, which includes dreams and fantasies and has no practical objective, and *realistic*, which includes all forms of reasoning and productive thought. Realistic thinking may be *deductive*, *inductive*, or *evaluative*. Deductive reasoning is a process of drawing conclusions from available data. In inductive reasoning something new must be added by the thinker and more than one solution may be appropriate. Evaluative thinking judges the soundness and appropriateness of an idea or product. Animals can think, although at a simpler level than man, as shown by tests of *delayed reaction* and by the somewhat more complex *double alternation* test.

Man has long surmised that the brain is the organ of thought, and recent research has revealed a number of relationships between electrical activity in the brain and mental activity. The cerebral cortex emits *spontaneous potentials*, rhythmic electrical oscillations which go on continuously, and *evoked potentials*, which are the responses made by the brain to specific sensory stimuli. These emissions yield EEG patterns which are highly consistent for a given individual. The tiny muscular contractions which occur during thought are called *implicit* speech or gestures and are detected by the measurement of *action potentials* produced by the contracting muscles. Even a slight delay or disruption in normal *sensory feedback* can seriously disrupt not only action but its accompanying thought processes.

Cybernetics is the science of control and communication in the organism and machine. It applies the principles of *servomechanisms*—machines which are intrinsically purposeful or goal-seeking—to computer operations and human behavior, describing both in terms of the basic components involved in a servomechanism—*input*, *throughput*, *output*, and *feedback*.

The most important tools of thinking are

imagery, *language*, and *concepts*. Rare individuals have *eidetic imagery*, almost like actual perception in its clarity and accuracy. The kind of visualization useful in complex thought, however, is not necessarily the same as visual imagery. Although words are probably not essential to thought and may sometimes even be a hindrance to it, language appears, in most instances, to be an aid in solving problems. The *Whorf theory*, which hypothesizes that language patterns are important in determining the thought patterns and even the perceptions of members of a given culture, is regarded by most anthropologists as too extreme a position but is a valuable tool for cross-cultural understanding.

Much of our education consists of learning to employ abstract *concepts*. There is some evidence that children learn successive systems of representation, depending first on *muscle patterns*, then on *images*, which permit simple thinking in the absence of the objects themselves, and finally on *symbols*, which permit abstraction and transformation of information according to a rule. Many concepts are formed through a process of *abstraction*, grouping objects in terms of some distinguishing common property. In doing so, there is a gradual decrease in dependence upon direct perceptual stimuli. Much adult concept formation is essentially a process of *dissociation* of elements common to several objects. According to the *informational approach* to concept formation, thinking is essentially a process of *transformation* in which information acquired in one form in one situation is altered to fit the requirements of another situation. This approach may provide a means of measuring the difficulty of thinking in various kinds of situations.

A large part of an individual's behavior involves *problem solving*, which utilizes the products of previous learning experiences and is itself a learning experience. Problems may be solved by *overt* or *covert trial and error* or both. *Insight*, or awareness of key relationships, may come suddenly or gradually. The following steps, which may be blended or interwoven, are involved in problem solving and creative thinking: (1) becoming concerned about or interested in the problem, (2) assembling the materials with which to work, (3) deriving a

number of possible solutions, (4) evaluating the suggested solutions, and (5) objectively testing and revising the solutions until an adequate one is achieved.

According to another theory of problem solving, all thinking illustrates one or more of three kinds of *gap-filling processes*. The simplest of these is *interpolation*, in which both the starting point and the terminal point are given. In *extrapolation* the terminal point is not given. In the third kind of gap filling, which includes most problem solving, the stopping place is defined and the necessary items of information are present, but in disguised form. Still another approach to problem solving regards it as essentially a process of thinking in *structures*, or *models*, which are sets of relationships and/or interdependencies between events.

Decision making is a complex form of problem solving, since each decision usually leads to others which are dependent upon the first one. Five elements are weighed in decision making: (1) the possible courses of action, (2) the possible external condition in which you may find yourself, (3) your opinion of the probability of each condition, (4) the outcome to be expected from each possible combination of actions and conditions, and (5) the positive or negative value to you of each outcome. The decision is ultimately derived from subjective and evaluative thinking. In fact, *bias* operates in decision making even where one is supposedly dealing with established probabilities rather than preferences, as in coin tossing. Such bias can sometimes be explained on the basis of *cognitive dissonance* theory, according to which cognitions that are dissonant tend to become more congruous and better balanced, often through a process of self-persuasion.

Success in problem solving depends on a number of factors, including our personal *context* and *specific set* of the moment, degree of *flexibility* or *rigidity*, *past experience*, and *freedom from stress or anxiety*. In general, the greater an individual's relevant experience in a given field, the more concepts and generalizations he will have as tools for solving new problems in that field; but rigidity, functional fixedness, or an inappropriate set may hinder problem solving. *Emotional attitudes* and *frus-*

tration and stress also interfere with logical reasoning.

The following eight rules have been suggested to aid in preventing rigidity in thinking: (1) run over the elements of the problem several times until an adequate pattern emerges; (2) suspend judgment; (3) explore the environment; (4) produce a second solution after the first; (5) critically evaluate your own ideas and those of others; (6) when stuck, change your representational system; (7) take a break when you are stuck; and (8) talk about your problem with someone.

Creativity, although often identified with the arts, may occur in any field of activity in which the individual shows originality and ability to integrate the elements of a situation into a harmonious whole. Creativity is more closely related to such personality traits as flexibility and sociability than it is to abstract intelligence. There is evidence that creativity may be improved by training.

Information theory is concerned with the principles that make for understanding, control, and predictability in communication. Any communication system has a *source*, a *transmitter*, a *channel* (over which both signals and "noise" may travel), a *receiver*, and a *destination*. Converting information into transmittable energy is called *encoding*, and the message is the *coded signal*, which is decoded by the receiver. *Information* can best be defined as a reduction in uncertainty. A unit of information, called a *bit*, is the amount of information which, when put into a system, reduces the number of alternatives by half. It is important to remember that effective communication requires adequate *feedback*.

Here is one form your questioning might take:

Q. "Is it one of the first four letters?"

A. "No."

Q. "Is it one of the last two?"

A. "Yes."

Q. "Is it the letter G?"

A. "No."

The conclusion is obvious: it is the letter H. This required only three bits of information.

Part Five Adjustment and Maladjustment

Chapter 11 Motivation and Drive

Chapter 12 Emotion

Chapter 13 Reactions to Frustration

Chapter 14 Mental Health and Therapy

No matter how carefully we trace the development of a person's abilities and other personality characteristics and no matter how accurately we measure them, we are still a long way from understanding his behavior. You have often heard remarks like, "Dave is so smart, I just can't understand why he doesn't accomplish more," or, "With his intelligence and ability to get along with people, Tom is silly to worry so much." Or you may have said to yourself, "Why on earth did I do that? I knew better."

Obviously we still need to understand the motivation behind people's actions—to know what makes them do what they do and what forces or conditions may hinder them from using their abilities to the full. This will be the concern of Part Five. First, we shall see that underlying every behavior pattern is a pattern of motives—a combination of interacting internal forces energizing and directing the individual's behavior along certain lines. Thus our behavior is much more than a mechanical reaction to external stimuli. We all have drives and emotions which can themselves propel us to action, and even responses to outside stimuli are affected by the patterning of these drives and emotions.

Knowing why people behave as they do is useful in all walks of life. The experienced senator, for example, has a practical understanding of some of man's social and political motives. The modern teacher makes learning easier and more effective by relating subject matter to the student's interests and needs. The

employer or supervisor is frequently called upon to apply his knowledge of human motives in his attempts to meet employees' basic personal needs, preserve industrial peace, and keep production at a high peak of efficiency. The wise mother knows that it is better to appeal to her child's need for approval than to resort to force. We all appraise almost unconsciously the needs, interests, values, and emotions that make people behave as they do.

In the constant process of attempting to meet both inner needs and environmental demands, no one can escape a certain amount of frustration and stress. In fact, adjustment is a never ending process of dealing with frustration. Our mental health is determined not by the amount of frustration we are subjected to but by how we deal with it. Some frustrations can be overcome, but we must "learn to live with" many others.

Sometimes, in attempting to adjust to extreme frustration, people adopt bizarre forms of behavior which are more incapacitating than the original frustration. Or they lose contact with reality almost completely. Such individuals may be brought back to normal mental health through various forms of therapy, some physical, others purely psychological in nature. We shall look at a number of commonly used methods of treating the mentally ill, from simple counseling to the comprehensive therapy available in mental hospitals. We shall also examine the philosophies behind various forms of therapy and the methods by which their effectiveness may be evaluated.

Chapter 11

Outline

GOAL-DIRECTED BEHAVIOR

- EXPLANATIONS OF MOTIVATION
- EFFECTS OF MOTIVATION ON BEHAVIOR
- PATTERNS OF MOTIVATION

BIOLOGICAL DRIVES

- MEASUREMENT OF BIOLOGICAL DRIVES
- THE HUNGER DRIVE
- THE THIRST DRIVE
- AIR HUNGER
- FATIGUE AND THE NEED FOR SLEEP
- WARMTH AND COLD AS DRIVES
- THE SEXUAL DRIVE
- PAIN AS A DRIVE
- BOWEL AND BLADDER TENSIONS
- THE NEED FOR CONTACT COMFORT
- BIOLOGICAL DRIVES AS HOMEOSTATIC MECHANISMS

PSYCHOLOGICAL MOTIVATION

- CURIOSITY—THE NEED TO INVESTIGATE
- THE NEED TO ACHIEVE
- THE POWER OF SYMBOLIC REWARDS
- THE IMPORTANCE OF MODELS
- MOTIVATION AND WORK

Chapter 11 Motivation and Drive

Human behavior, as well as that of the lower animals, can be spoken of in terms of two basic but interacting characteristics: (1) *plasticity*, or modifiability; and (2) *energetics*, or variability in the intensity of responding. The first of these characteristics is involved in the learning process; the second is involved in motivation.

The idea that behavior is motivated has been a subject for reflection and discussion by philosophers since the earliest recorded times. The ancients frequently invoked supernatural "forces" or demons as explanations of how behavior is aroused and directed. Indeed, as late as the early twentieth century the French philosopher Henri Bergson propounded the idea of an *élan vital*, or creative force, acting within all organisms. Because of such ideas the study of motivation fell into disrepute for a time among science-oriented psychologists and was left to the philosophers and the poets. In fact, Edward C. Boring's classic *History of Experimental Psychology*, published in 1929, makes no mention of motivation. More recently, however, the study of motivation has gained scientific status, as the psychologists have joined hands with the physiologists in trying to understand it. The study of motivation is now seen as the study of the conditions that arouse, sustain, and direct behavior.

GOAL-DIRECTED BEHAVIOR

In any action beyond a simple reflex, the organism is guided by patterns of internal conditions. These complexes of internal conditions,

called *motives* or *drives*, serve to direct the organism toward specific goals. The psychologist infers their presence when he observes "persistent behavior which appears to be dominated for the time being by a relatively limited group of stimuli acting on the organism" (Bunch, 1958). Thus a hungry animal, be he a dog or a man, will turn from other activities and move about in his environment until he finds and ingests food. His behavior is similarly persistent when water is lacking and violently so when breathing is interfered with. The stimulation associated with such basic tissue needs is the simplest kind of motivation.

A motivated act is complete when the goal is reached—the goal (also called "reward" or "incentive") being some substance, object, or environmental condition capable of reducing or temporarily eliminating the complex of internal conditions which initiated action. The action which achieves this goal is called a *consummatory response*.

Explanations of Motivation

The earliest attempts by psychologists to explain human drives tended to be one-sided and oversimplified. In rejecting the idea that men were controlled by instincts similar to the inherited behavior patterns of birds and animals, behaviorists for a time overemphasized the role of external stimuli in controlling behavior. Other theorists placed too much emphasis on local, internal sensory stimulation, such as that produced by contractions of the walls of the stomach in hunger.

The first truly modern approach to the problem of what motivates behavior was made by K. S. Lashley (1938), who regarded motivation

as being controlled by the responses of the central nervous system to a complex variety of internal and external stimuli, including changes in the chemical composition of the blood stream. Without trying to locate the neural mechanism responsible for this control of biological drives, Lashley indicated what some of its characteristics must be. He pointed out that motivated behavior does not consist simply of chains of stimulus-response sequences. Conditions within the organism alter the responses that given stimuli elicit from one moment to another. Furthermore, motivated behavior depends not upon a single stimulus but rather upon a complex pattern of stimuli, even when a single stimulus triggers the response. Thus motivation varies greatly on different occasions and among different individuals. Building upon these concepts, physiologists and psychologists have been able to learn a great deal about the role of the central nervous system in controlling motivation, as we shall see in this chapter.

The relationships between motivation and learning and their relative contributions to behavior are complex and difficult to study. Not only must both be inferred from behavior instead of being observed directly, but it is impossible to devise a situation in which we can be sure that only motivation or only learning is operating. Any situation in which motivation is measured incorporates some elements of past learning, and learning in the absence of motivation cannot be demonstrated because we can never be sure that no motivation is present. Like the influence of heredity and environment on development, the relationship between motivation and learning in determining behavior is probably a multiplicative one rather than an additive one. In Chapter 6 we reviewed the efforts of one theorist, Clark Hull, to formulate this relationship in a way that would explain the known facts and lead to testable hypotheses.

Effects of Motivation on Behavior

As already suggested, human motivation influences behavior in two ways:

1. Motives determine the direction of behavior and thus change the organism's relation to

its environment. Sensitivity to certain stimuli is increased, causing the relevant external stimulus pattern to win over competing ones. Thus a hungry student smelling breakfast cooking may not "see" and correct the disarray of his room, whereas the same young man, as a soldier preparing for an imminent inspection, may not realize that he is hungry or notice the smell of food cooking.

If relevant external stimuli are not present at the time, motives cause the individual to search until he encounters an appropriate external object or situation. For example, as mealtime approaches, we stop what we are doing and go in search of food.

2. Motives make energy available for the activity required. They do this through the action of a general arousal system. Thus, although a drive or motive directs the organism toward some goal which will satisfy a particular need, it can also work as a general energizer (Champion, 1957).

The arousal component of motivation can be measured by instruments recording the level of activity of organs controlled by the central nervous system or of those controlled by the autonomic nervous system.

In a study of the relationship between certain physiological functions controlled by the autonomic nervous system and performance in mirror tracing, forty-three Canadian airmen between the ages of seventeen and thirty-five served as subjects. Their task was to trace the outline of a circle four times in succession while viewing the paper in a mirror which reversed the vertical dimension but did not affect the horizontal dimension. A machine known as an *electromyograph* was used to measure and record in a continuous tracing the degree of tension present in the forehead, the right-forearm extensor muscles, and the right-forearm flexors. Tracings were also recorded of respiration, heart rate, and blood pressure (taken, of course, in the left arm). All recordings began thirty seconds before a trial and ended thirty seconds after it. There were a total of eight trials, with three minutes' rest between them.

As shown in the graphs, strikingly similar curves were obtained for the measures of tension in skeletal muscles and the autonomic measures. The main conclusion of the study was that the physiological activity which accompanies mirror tracing performance is not confined to the skeletal muscle system but can be clearly

observed in functions which are controlled by the autonomic nervous system. This suggests that these latter functions share some of the mechanisms of central neural control and are components of the arousal function (Malmo and Davis, 1956).

Numerous lines of evidence have indicated that the relation between arousal and excellence of performance is in the form of an *inverted U*. That is, the effect of increased arousal on efficiency is beneficial up to a point, but beyond that has bad effects.

In a study designed to test the inverted U hypothesis, the performance of thirty-one subjects on an auditory tracking task under a wide range of conditions of motivation was compared. These conditions varied from one in which the subject was led to believe that his scores were not even being recorded to one in which his score could enable him to avoid a shock of 100-150 volts or to earn a bonus of \$2.00 to \$5.00. In general the results strongly supported the hypothesis (Stennett, 1957).

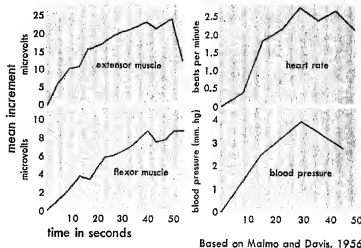
The same stimulus may arouse the organism to action and also perform a *cue* function—that is, indicate the direction of appropriate activity (Hebb, 1958). For example, the smell of cooking not only arouses the organism to seek food but also provides cues as to where the food may be found. Sometimes, however, different stimuli are necessary for the two functions: stomach contractions may be part of the general arousal pattern, whereas visual or olfactory stimuli may be needed to perform the cue function and determine the direction of food-seeking activity.

Patterns of Motivation

When a goal is achieved, inactivity does not ensue, for as one motive is satisfied, the demands of others become more insistent. Perhaps hunger is the most impelling drive when you wake up in the morning. But with breakfast over, you are motivated by the need to get to class on time. The achievement of one goal may even lead directly to the formation of new ones. In passing a course in elementary psychology, for example, you may acquire such a strong interest in mental disorders that taking a course

FOUR MEASURES OF PHYSIOLOGICAL AROUSAL

To make the curves comparable, increases were expressed as ratios. The close similarity of the four curves—two measures of skeletal muscle tension and the other two autonomic measures—demonstrates the generalized nature of arousal.



in abnormal psychology becomes a new goal for you.

Different motives acting within the organism are not necessarily compatible, but may actually be at odds with one another. When this is the case, one motive or complex of motives may render ineffective others that would normally be very strong. For instance, a hungry person may refrain from eating if the only food available to him is something that he has been taught to avoid for religious reasons.

The internal conditions which arouse and direct an individual's responses to objects and situations in the environment fall into two groups: (1) *biological drives*, resulting usually from such basic tissue needs as those for water, food, oxygen, sleep, warmth, or coolness, and (2) *psychological motives*, resulting from such needs as those for social approval, self-esteem, security, and knowledge. The biological drives are *innate*, although the ways in which they are satisfied are greatly influenced by learning and cultural factors. The exact origin of psychological motives is still a matter of lively debate, but most of them seem to be *acquired* as the result of experience and are greatly influenced by cultural factors.

BIOLOGICAL DRIVES

Biological drives originate in the organism's undeniable biological requirements. These drives motivate the behavior of the organism in directions that lead to the required changes in internal environment. For example, the hunger drive motivates the organism to seek and ingest food, which is necessary to maintain metabolism. Prolonged failure to satisfy certain of the biological drives results ultimately in impaired health, disease, or even death. The drives which have been recognized and studied, and which will be discussed here, are those related to our needs for food (including a variety of specific substances), water, oxygen, rest, and sleep; for maintenance of a moderate temperature; for relief of sexual urges, pain, and bowel and bladder tensions; and for contact comfort.

Drives influence behavior from birth and are present even during fetal life, although normally at that time they are automatically satisfied by the mother's body. The biological drives arise out of inherited structures and are present in every human being as well as in the lower animals. The specific sequence of actions which the individual employs to *satisfy* a particular drive, however, is subject to much modification through learning.

Measurement of Biological Drives

Much of man's knowledge of the biological drives has come from careful study of the behavior of animals under experimental conditions. Since measurement and quantification is the basic aim of any science, psychologists and physiologists have developed numerous ways of measuring the strength of drives. They do this by varying the intensity of drive stimulation and observing the effect produced on some facet of behavior. The stimuli which are varied may be internal to the organism (as amount of food or water deprivation) or external (as the amount of electrical current applied to the skin). The biological effects are measured by any one or more of the following: (1) gross motor

activity; (2) rate of responding; (3) amount of obstruction required to prevent the animal from reaching an appropriate goal; (4) preference shown by the animal when given a choice of two or more goals; (5) force or amplitude of a response; (6) action of the autonomic nervous system; and (7) speed of learning.

Let us look at some of the significant facts about the various biological drives.

The Hunger Drive

Of all the drives, hunger has received the most study. The nature of the internal conditions in hunger is quite complex.

The hunger stimulus. From introspection we know hunger as a mass of sensations seeming to come from the region of the stomach. But just what are the changes that produce these sensations? Is the stomach their source? Can "hunger" exist without them?

Understanding of the hunger mechanism has been advanced through the combined efforts of psychologists and physiologists, who have performed various types of observations on the behavior of the empty stomach. One early method of studying stomach behavior was to have the subject swallow a thin rubber sack, like a balloon, attached to a long rubber tube. The experimenter could adjust this sack in a position at the upper end of the subject's stomach and inflate the sack until it came into snug contact with the walls of the stomach. The free end of the tube was connected to a recording device which made a graphic record of any change of pressure in the balloon (Cannon and Washburn, 1912).

Continuous records of stomach behavior over a period of several hours revealed two types of stomach behavior: that associated with digestion and that occurring when acute hunger was reported. Only the regular churning movements of digestion were observed immediately after eating, but as the stomach emptied, the

contractions associated with hunger set in. They appeared about every hour and a half at first but came more frequently as the length of time without food increased. The subject reported hunger pangs which occurred at the time of strong stomach contractions. Thus the sensation of hunger was ascribed to vigorous contractions of the empty or nearly empty stomach (Cannon, 1934). ▲

Newer evidence suggests that the balloon technique may give misleading results. By recording the activity of the stomach muscles electrically, one group of investigators found that the presence of a balloon in the stomach *caused* contractions instead of simply recording them (Davis, Garafolo, and Kveim, 1959).

Convincing evidence that hunger sensation is not necessarily due to contractions of the empty stomach comes from a study in which men were kept on a semi-starvation diet for several months. After a prolonged period of malnutrition, awareness of hunger was greatly accentuated. The subjects frequently reported feeling hunger pangs immediately after a large meal. Although awareness of hunger under such conditions may have been associated with strong stomach contractions, it is obvious that it was not caused by emptiness of the stomach (Keys, Brôzek, Henschel, Mickelson, and Taylor, 1950).

Current indications are that hunger sensations have causes more remote than the emptiness of the stomach.

Rats whose stomachs had been removed showed hunger behavior in practically the same way that normal animals (used as a control group) did. They learned a maze when food was the reward just as quickly as did the controls, and they were equally active as feeding time approached. The only difference was that the rats without stomachs sought food more often than the control animals, which would be expected since they had only their intestines for food storage and hence had to eat more often (Tsang, 1938).

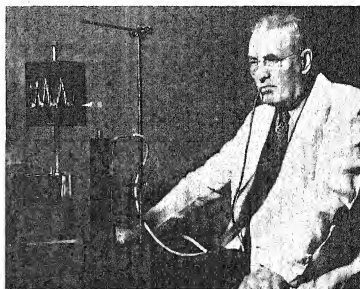
This evidence indicates clearly that hunger exists in the absence of stomach contractions. It seems, therefore, necessary to distinguish between hunger sensations arising from stomach contractions and the hunger drive itself. It has been said that the hunger drive says *that* one

should eat and hunger sensations, strongly influenced by social custom, say *when* one should eat.

Some findings suggest that the origin of the hunger drive is chemical in nature. Studies have shown, for instance, that blood transfused from the body of a starving dog to that of a recently fed one can cause stomach contractions under certain conditions (Luckhardt and Carlson, 1915; Tschukitschew, 1929). It has also been found that transferring blood from a recently fed animal to a starving one stops stomach contractions in the latter (Bash, 1939).

There is evidence that the level of sugar in the blood acts on centers in the brain that can excite the major nerve leading to the stomach, which in turn causes strong stomach contractions (Janowitz and Ivy, 1949). Further support for the hypothesis that blood sugar controls hunger is found in the fact that a drop in the level of blood sugar following an injection of insulin induces hunger—and stomach contractions (Goodner and Russell, 1965).

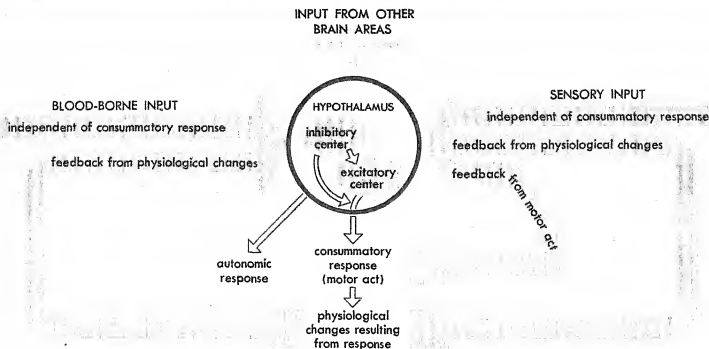
Inhibition of eating occurs as a result of loading the stomach with nonnutritive bulk. This inhibition has been explained as a learned inhibitory response, since bulk and satisfaction of hunger have regularly occurred together in the



▲ The late Dr. Anton J. Carlson is shown here with the stomach-balloon apparatus which he developed. Pressure on the balloon causes the stylus to move up and down on the revolving drum, producing a record of stomach activity.

INFLUENCES ON HYPOTHALAMIC FUNCTION

For each biological drive there is believed to be an inhibitory center and an excitatory center in the hypothalamus. Input is received from other brain centers, from external stimulation, and from blood-borne messages. This input includes a running report on the state of the organism and the environment as well as both sensory and chemical feedback from actions already taken or in progress.



Adapted from Stellar, 1954, and McCleary and Moore, 1965

past (Smith and Duffy, 1957). Or it may simply be that eating ceases because the stomach will hold nothing more. Whichever the case, this relationship is taken advantage of in certain patent medicines sold to kill hunger in people on a diet.

The mechanism of hunger satisfaction. How does the hungry organism know when it has eaten enough? The mechanism involved in "metering" food intake is related to but different from that of the hunger stimulus. One hypothesis is that metering takes place in the mouth as a function of the quantity and taste qualities of the materials passing through it. The validity of this hypothesis has been tested by means of "sham feeding" experiments in which animals are operated upon surgically so that food entering the mouth is chewed and swallowed but passes through an opening in the esophagus and never reaches the stomach (Janowitz and Grossman, 1949). Animals sham

fed in this way do stop eating, but only after the food intake is much greater than it would have been had it reached the stomach. Apparently some metering by means of feedback in the mouth does occur, but it is gross and inaccurate.

On the other hand, the rat can regulate its food and water intake perfectly in the absence of taste, smell, or tactile sensory input from the mouth or esophagus. Investigators who placed food directly in the stomachs of rats through an oral-esophageal bypass, thus eliminating taste, smell, and tactile stimulation of the mouth, concluded that post-ingestional factors are sufficient "... to control the onset of feeding, the size of meals and the total amount of food eaten during a single day and for longer periods of time up to a month" (Epstein and Teitelbaum, 1962).

Other studies have led to the conclusion that intake is normally regulated by both taste stimuli and post-ingestional factors. The critical re-

ceptor in the stomach is believed to work by osmotic action, responding to the concentration of dissolved particles in the blood (Mook, 1963; Pfaffmann, 1961; Smith and Duffy, 1957; Stellar, Hyman, and Samet, 1954).

The dual nature of the mechanism for hunger satisfaction is further indicated by the fact that while animals learn to perform a new response when the food reward is injected directly into the stomach, producing stomach fullness and satisfying metabolic needs, they learn much more rapidly when the food is taken in the normal fashion, thus involving both oral and post-ingestional factors (Miller and Kessen, 1952).

Hunger and the hypothalamus. Whatever the factors are that produce hunger and control both eating and the cessation of eating, they seem to operate through the hypothalamus, in which both inhibitory and excitatory centers have now been identified. Surgical removal of the inhibitory center causes overeating and gross adiposity. Electrical stimulation of it causes undereating. The opposite effects are obtained in the case of the excitatory center. Here removal causes cessation of eating whereas electrical stimulation causes overeating. Electrical stimulation of the excitatory center can also serve as a reward or reinforcement in operant conditioning even when no actual food is given (Margules and Olds, 1962).

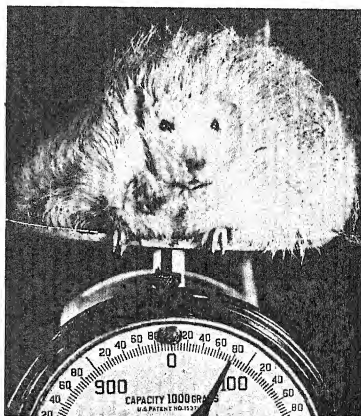
The hypothalamus is in direct contact with the cerebrospinal fluid and also contains more blood vessels than any other part of the central nervous system. Stimuli of all kinds—chemical, sensory, neural, circulatory—act on its numerous receptors. The way in which they balance the excitatory and inhibitory influences is a partial determinant of the strength and nature of hunger (and other drives).

It should be pointed out, however, that the hypothalamus is not the only brain center involved in the hunger drive. Other nearby centers have also been found to play a role in controlling feeding behavior, and if the hypothalamic centers are destroyed their functions can evidently be taken over by other structures if the animal can be kept alive for a sufficient length of time by forced feeding (Teitelbaum and Stellar, 1954).

Hunger and sensitivity. Not surprisingly, human beings can recognize indistinct pictures of food more readily when hungry.

In one experiment 110 male college students were shown slides for very short intervals, half of them pictures of food and the other half pictures of miscellaneous objects. Between three and four hours after eating, subjects could recognize the food pictures more and more readily. After five or six hours, however, they no longer recognized the food so readily. This is consistent with the pattern which most people experience of being sharply hungry as mealtime approaches but having their hunger decrease if the meal is missed. The subjects' ability to recognize the nonfood pictures in this experiment remained the same throughout (Lazarus, Yousem, and Arenberg, 1953).

The hungry organism is more than normally sensitive to its environment, even to factors that are not clearly related to food. Hungry rats, for example, show a much greater reaction to changes in light and sound than do rats that are not hungry.



● This picture graphically illustrates the effects of destroying a rat's inhibitory eating center.

The stimulus in this study was an increase in light and the simultaneous cessation of sound from a fan. As shown in the graph, activity with stimulus presentation was greater than activity without it even before starvation began. When the starvation period began, the activity level of the rats without stimulus presentation increased, but not nearly so sharply as did that of the rats with stimulus presentation (Campbell and Sheffield, 1953).

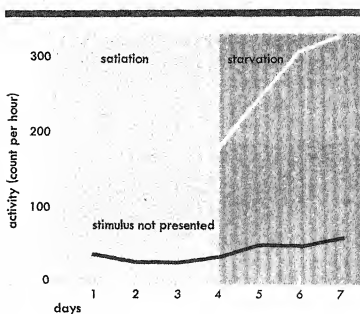
Rats also show particular responsiveness to the environmental changes that normally occur just before feeding time (Sheffield and Campbell, 1954).

Effects of semistarvation. Conditions of famine often follow in the footsteps of war. The Allied invasion of Europe toward the end of World War II liberated millions of famine victims, both civilians and war prisoners. A sound program for rehabilitating these famine victims was hindered by the lack of a well-controlled study on the effects of semistarvation. This need was met by a group of scientists at the University of Minnesota who conducted an elaborate experiment.

Thirty-six subjects, conscientious objectors who participated voluntarily, were used in the study. The experiment, which began in 1944 and lasted nearly a year, consisted of three phases: (1) a twelve-week control period, during which the subjects received a well balanced diet designed to represent the fare eaten under good economic conditions in the United States; (2) a twenty-four-week semistarvation period, during which the subjects were maintained on a diet characteristic of European famine areas; and (3) a twelve-week rehabilitation period, during which the subjects were carefully nourished back toward normal. The experimental semistarvation diet consisted mainly of bread, macaroni, potatoes, turnips, and cabbage. It provided only 1570 calories a day, as compared with an average of 3492 calories a day in the "normal" diet received during the control period.

Throughout the experiment the subjects were kept on a full-time weekly schedule of experimental routines. Each participant was assigned to fifteen hours a week of physical work, such as helping in the laundry or maintaining the living quarters. Each subject was also required to walk twenty-two miles a week out-of-doors and half an hour a week indoors on a treadmill. Another

▲ HUNGER AND SENSITIVITY TO ENVIRONMENT



Based on Campbell and Sheffield, 1953

er twenty-five hours a week were devoted to educational activities. Each subject was given regular physiological and psychological checkups.

The physical changes produced by the twenty-four-week period of semistarvation were, of course, profound. Accompanying a 25 per cent loss in body weight were a 40 per cent decrease in basal metabolism and a 30 per cent reduction in body strength, which made a difficult maneuver out of a simple task such as climbing stairs. Sexual urges decreased markedly and were slow to return during the rehabilitation period. Subjects "cooled" noticeably toward their girl friends and courtships collapsed. The men seemed practically incapable of displaying affection.

So striking were personality changes during the experiment that the authors of the study adopted the term "semistarvation neurosis" to describe the symptoms which appeared as a result of the semistarvation and then disappeared when the subjects returned to a normal diet. The outstanding characteristic of the "neurosis" was apathy. Humor disappeared, a depressing air of gloom and dejection appearing in its place. There was also a marked decrease in sociability. The men became nervous and irritable, tended to be boorish and tactless when invited to parties, sometimes went unsuited and dressed sloppily, lost their cooperative spirit, and were inclined to "blow up" at each other. Self-confidence was replaced by feelings of inferiority and depression.

Tests of intellectual capacity administered at different times throughout the study failed to reveal any marked changes, although the subjects' general level of performance on such tests did decrease slightly. This lowered level of performance may be attributed to general physical impairment. Because of their constant preoccupation with thoughts of food and their inability to concentrate on other things, the subjects worried considerably about declining in intelligence and believed that they were really suffering such a loss.

There can be no doubt that by the end of the semistarvation period the hunger drive had become the dominating dynamic factor affecting the behavior of the subjects. Food, either directly or indirectly, dominated their conversation, reading, leisure activities, and daydreams. More than half of the men devoted their spare moments to reading cookbooks and collecting recipes. Others became intensely interested in such subjects as dietetics, agriculture, and frozen food lockers. Some subjects even gave serious consideration to the idea of changing their occupations and becoming cooks (Keys et al., 1950; Guetzkow and Bowman, 1946).

Awareness of hunger is much more insistent under conditions of semistarvation than with total fasting. After several days of complete abstinence from food, hunger disappears almost entirely, but in cases of prolonged semistarvation, where a small but inadequate amount of food is available, it grows increasingly until it dominates the individual's consciousness and behavior.

Specific hungers (appetites). In addition to the general hunger drive, specific hungers often develop when the body needs certain substances. These hungers are particularly evident in the lower animals. Cattle deficient in minerals will eat bones. Rats, although they do not always thrive when allowed to select their foods cafeteria style, will often show a preference for foods needed to make up a deficiency.

In one study twenty rats were fed a diet deficient in vitamin A for twenty-two days, while ten control rats were given an adequate diet. At the end of this time a cup of compressed alfalfa meal, high in Provitamin A (a substance which can be converted by the body to vitamin A), was placed in each cage in addition to the regular diet. For fourteen days both groups ate about the same amount of the alfalfa, but after that the rats



◆ During the semistarvation period of the Minnesota experiment, the hunger drive became the most important factor affecting the subjects' behavior. The men became unsocial, frequently ignoring such amenities as table manners (above). Physical changes were also evident (below); subjects became haggard, emaciated, subject to fainting attacks, and easily fatigued.

which had been deprived of vitamin A ate larger and larger amounts of it (Harriman, 1955b).

Human beings also show some evidence of being able to satisfy specific bodily needs. In infancy, at any rate, a human being may largely be trusted to prefer the foods that are best for him.

In a classic study, three newly weaned infants were allowed to select their foods from a wide variety of wholesome foods, both raw and cooked. Two of them selected their foods for six months, the other for a full year. All three subjects gained normally and showed no signs of nutritional disorders. In fact, one baby who suffered from rickets at the beginning of the experiment cured himself by choosing large quantities of cod liver oil, which contains the vitamin D required to overcome rickets. The baby gave up the oil when the rickets disappeared. All babies tended to eat large quantities of one food for a time and then switch to another, going on "egg jags" or "cereal jags." But in the long run they obtained a balanced diet (Davis, 1928).

Primitive peoples also show remarkable wisdom in choosing foods which satisfy their needs, though their choices often seem bizarre to us. A typical Eskimo meal, for example, might include the skin of the white whale (as rich in vitamin C as orange juice) or the vegetable content of diving birds' stomachs (Sinclair, 1954a). The latter item is necessary to supplement an almost exclusively meat diet. Acquired taste, however, may interfere with the organism's natural ability to choose the type of food that it needs, as shown by the following study.

If the adrenal glands are removed, the organism requires abnormal amounts of salt. Normally rats ingest extra salt after removal of the adrenals, preferring salt solution to glucose solution when offered a choice. But more "sophisticated" rats that have had experience with both sweet and salty solutions before their operation will choose the glucose and die (Harriman, 1955a).

Interestingly, it has been found that rats deficient in protein will select sucrose rather than protein whenever they are placed in a test situation in which they have formerly selected sucrose. In a new and different test situation, however, they will choose the needed protein. If the experimenter alternates the old and new situa-

tions, the rats will alternate in their choice of sucrose and protein (Young, 1944).

Unfortunately civilized man, like these "educated" rats, has formed many food habits—such as the American taste for candy and cola drinks—which are not in accord with bodily needs. Thus the "wisdom of the body," though remarkable in primitive conditions, may be undermined by acquired tastes.

The Thirst Drive

Although man can live for many weeks without food, he can survive only a few days without water. Men who have been completely deprived of both food and water for long periods of time report that the sensations of thirst soon become maddening, whereas the pangs of hunger tend to disappear after a few days.

Effects of the thirst drive. Hunger and thirst not only differ in intensity but also cause pronounced qualitative differences in behavior, at least in the lower animals. In experiments with rats it has been found that thirsty animals learn to find a reward of water more quickly than hungry ones learn to find food when the rewards are in the same location in a maze. However, when rats have to learn to go to different goal spots on alternate trials, the hungry rats learn to alternate between the two locations more readily than do the thirsty ones (Petrinovich and Bolles, 1954). This suggests that the behavior of thirsty animals tends to be more stereotyped than that of hungry ones.

How thirst operates. The thirst drive is a regulatory device which serves to control the intake of water into the body in such a manner as to maintain a constant water content. Exactly what all the factors in thirst are—just how a lowered water level activates the thirst drive—is still only partially understood by physiologists and psychologists.

Undoubtedly, dryness of the mouth and throat tissues is one important component of the thirst drive. As the water supply in the body becomes low, the tissues of the oral cavity become dry; this dryness stimulates tiny nerve

endings embedded in the mouth and throat and produces consciousness of thirst. But this feeling of thirst can be relieved to a considerable extent by washing the mouth with water and then spitting it out even though such a practice does not affect the water content of the blood or body tissues. That oral factors are by no means the only ones involved in thirst is further attested to by the following experiments.

In one study, dogs were deprived of water long enough for a water deficit to build up in their bodies. After this period of deprivation, an amount of water equal to the deficit was placed directly in their stomachs so that it did not pass through the throat and mouth. After different lengths of time, the animals were permitted to drink naturally. The dogs allowed to drink immediately after water was placed in the stomach drank as much as they would have needed to consume if water had not been placed in their stomachs. But when dogs were not allowed to drink for fifteen minutes after water was placed in their stomachs, they did not drink at all. In other words, when time was allowed for the body to assimilate the water which had been placed in the stomach, the animals were not thirsty—even though the mouth and throat had not been watered (Bellows, 1939). It is possible, of course, that the water injected into the stomach had passed into the blood stream and thence to the linings of the throat.

In another study, thirst was measured not only by the consummatory response (drinking to satiation) but also by a learned instrumental response—the rate at which rats pressed a bar when the reward was a small amount of water. The immediate aftereffects of three treatments were examined: (1) 14 cc. of water drunk by mouth, (2) 14 cc. of water injected into the stomach, and (3) no water given. Water injected into the stomach produced a prompt reduction in response, though not as great a reduction as was produced by water drunk in the normal manner. There was no change when no water was given (Miller, Sampliner, and Woodrow, 1957).

Another complex series of experiments was performed with rats and rabbits.

When water was placed directly in the stomach, drinking was largely inhibited—even during the first few minutes after the injection, before there was time for the water to be absorbed. Distention of the stomach by means of a balloon had a similar inhibitory effect on

thirst. However, when water was injected into the tissues rather than placed in the stomach, there was still some urge to drink, indicating that the condition of the stomach tissues plays a part in thirst.

In the same series of experiments it was also found that the animals greatly increased their water intake after having received injections of salt solution or urea (Adolph, Barker, and Hoy, 1954). In another study the injection of salt solution under the skin caused satiated rats to drink as much water as very thirsty ones (Heyer, 1951).

Evidently the concentration of salt and other chemical substances in the body fluids, as well as the total amount of fluid present in the body, helps to determine thirst.

The hypothalamus apparently plays a role in activating the thirst drive. Electrical stimulation of the hypothalamus of goats through permanently implanted wires causes prompt drinking each time the electric current is delivered. This may go on until the goat has taken on water to the extent of 40 per cent of its body weight. Injection into the hypothalamus of a minute amount of solution containing a higher concentration of salt than does the blood causes excessive drinking, suggesting that the hypothalamus cells respond directly to the level of salt in the blood (Andersson and McCann, 1955).

Thirst is only one factor in the maintenance of the proper hydration of the tissues. The output of water in the urine is equally important in striking a balance. Water output is also controlled by the hypothalamus in a powerful but roundabout fashion. Nerve cells in certain hypothalamic nuclei send axons down the stalk of the pituitary gland, causing a hormone to be released into the blood stream. On reaching the kidneys, this hormone causes them to retain water. It is interesting that the hormone is not formed in the pituitary gland but is only stored there; it is formed in the hypothalamic nuclei and passes down the axons in the pituitary stalk. This is a striking example of *neurosecretion*. Somewhere in the head, probably in the cells in the hypothalamic nuclei which produce the hormone, are receptors sensitive to the concentration of salt in the blood and thus indirectly to the amount of water. If the animal is dehydrated, hypothal-

amic cells are stimulated, the hormone is released, the amount of water secreted by the kidneys is reduced, and balance is obtained. Water balance is a good example of the way psychological and physiological factors interact to maintain life.

Air Hunger

One of the constant requirements of the body is oxygen. Yet we have no sensory awareness of oxygen lack as such. A miner entering a pocket where oxygen has been replaced by marsh gas (methane) loses consciousness without any feeling of air hunger to give him warning. It is when carbon dioxide collects in the lungs (as when the breath is held or the respiratory pathways are obstructed) that we feel immediate discomfort and eventually intense pain if our reflex breathing out does not get rid of the carbon dioxide and draw in air. The effective stimulus to the mechanism of air hunger is the presence of excess carbon dioxide rather than the deficiency of oxygen.

The importance of a continual oxygen supply to the body, especially to the brain, cannot be overemphasized. Although the nervous system consumes oxygen in very small amounts, this consumption goes on constantly, and severe oxygen deprivation (*anoxia*) for periods as brief as a minute can result in actual neural damage. Temporary asphyxiation at birth (due to failure of the neonate's breathing apparatus to begin functioning when the umbilical cord is severed) may cause serious damage to the brain, resulting in mental retardation or other abnormalities.

In one study of over 200 mentally retarded children, over 70 per cent of the cases were discovered to have suffered severe anoxia at birth. Many of the retarded children also showed other signs of brain damage such as epileptic seizures and paralysis (Schreiber, 1939).

These findings have been confirmed in a much larger and more recent study of more than 40,000 births. Mental retardation was found eight times more often among the children who suffered anoxia than among their siblings who had normal births (Benaron *et al.*, 1960).

A history of severe anoxia at birth is almost never found in normal children.

When oxygen starvation occurs in an atmosphere without excessive carbon dioxide—as on mountaintops and in high-altitude flying—a peculiar sort of intoxication results. The person loses control of himself and may shout, fight, or burst into tears. Memory is impaired, the senses function poorly, and paralysis is apt to occur, especially in the legs. Yet the person feels confident of his abilities and fails to realize the seriousness of his condition. Many victims of near-drowning, as well as some skin divers who “stretch their air” suffer permanent brain damage.

Fatigue and the Need for Sleep

Everyone is aware of how desperate the need for rest can become. The neurophysiological basis of fatigue is unknown, although a great deal is known about chemical changes involved in muscular activity. As a result of prolonged exercise, the chemistry of the blood is altered in several ways. One change involves an increased concentration of lactic acid in the muscles. Presumably this condition stimulates the nervous system directly or activates certain receptors. The picture is complicated enormously, however, by the fact that much of our fatigue seems to result not from physical exertion but from frustration, worry, or boredom. Some neurotics, for example, are chronically exhausted, no matter how little activity and how much rest they have.

Tired people go to great lengths to obtain rest. When fatigue is physically induced, rest brings a cessation of the persisting stimuli which cause consciousness of fatigue and impel the organism to seek rest. But if fatigue is emotionally based, rest probably will not bring relief. In such a case the answer more likely will be realized through the resolution of emotional tensions or provision of more interesting activity.

One of the most extreme forms of fatigue, actually amounting to pain, can be produced by the steady contraction of a muscle. It is thought that many headaches and sensations of eyestrain are caused by such sustained

muscle contractions, which cut down the blood supply, thus causing the accumulation of some substance that normal circulation would flush out by pressure and oxygenation. This substance may be a neurosecretion released by nerves around the small blood vessels of the muscle, rather than one of the products of muscle metabolism. It has been suggested that the chronic fatigue experienced by the neurotic may be the result of constant muscle tension (Ruch, 1965).

Because certain drugs such as chloroform and ether produce a relaxed condition resembling sleep, it has been suggested that the basis of sleep may be partly chemical. In sleepiness, our nerve and brain centers are perhaps directly stimulated by chemical conditions within the body. The muscles are also involved, for one of the conditions essential to sleep is a general relaxation of the body.

Whatever the chemical factors in sleep, it is known that sleepiness can be caused by injuries to certain parts of the brain, particularly some of the lower brain centers. Possibly these centers control the sleep drive.

The pattern of behavior by which we satisfy the need for sleep is largely the result of cultural factors. Most cultures have developed sleep patterns that depend upon the regular alternation of light and darkness. There are a few ex-

ceptions, however, such as the daily "siesta" of people in some of the hot countries and the custom of a tribe of Bolivian Indians of sleeping for short periods regardless of the time of day or night.

An interesting study investigated sleep patterns among the people of Tromsø, Norway, who must sleep under the midnight sun during part of the year and spend their waking hours in darkness during the winter season.

The investigators found that though residents of Tromsø might often be seen mowing the lawn or playing a game of tennis around 11 o'clock on a summer evening, there was little street traffic after midnight. The arrival or departure of night boats attracted gay crowds, causing tourists to carry away an impression of a wide-awake town. But this night activity, localized near the piers, died away completely after the boats left. In fact, when the investigators tried to count the number of persons crossing the city square late at night, they found there was no one to count.

They found that about a quarter of the persons they interviewed were in bed by 9:00 P.M. in winter. But even in summer many went to bed as early as 9:30, and 78 per cent went to bed between 11:00 P.M. and midnight. The average retiring hour was only about an hour earlier in winter than in summer.

Only a few reported using drugs to induce sleep; those who did so used them more often in winter than in summer. Hours of rising were about the same the year round, but more subjects woke up feeling sleepy and unwilling to get out of bed in winter than in summer. On the whole, then, the sleep-wakefulness pattern in Tromsø was quite similar to that in other civilized communities (Kleitman and Kleitman, 1953).

Studies have shown that it is possible to go without sleep for as long as one hundred hours with only slight losses in efficiency in the performance of relatively simple tasks. In complex tasks, however, performance declines significantly during the course of fifty hours without sleep (Clark *et al.*, 1946).

The effect of thirty hours without sleep on performance of a complex discrimination task is shown by the following experiment.

The apparatus consisted of twenty small cards attached to a rotating loop of film. The subject was to compare each of the moving cards with each of ten stationary ones in order to determine the number of



● Early studies of sleep were carried out by Dr. Nathaniel Kleitman. He is shown here with an assistant during a month spent in Mammoth cave during which the men tried to adjust to a 28-hour day. One was able to do so; the other was not.

differences between the sets. Each card was marked with six symbols, regularly located. One of two symbols appeared in each location on all cards—that is, in the upper left corner would be either an X or an O, in the upper right corner either a / or a V, etc. Thus in each comparison there might be as many as six differences between the cards.

Subjects were required to make comparisons every six seconds for twenty-five minutes. All subjects performed the test on the morning of the same day. The experimental subjects were then allowed to do anything they wished except sleep for the next twenty-four hours. After this period the test was administered to all subjects again. A third session was held six hours later. The performance of the experimental subjects declined slightly during the experiment, while that of the controls (who presumably had a normal night's sleep) improved considerably (Chiles, 1956).

Though individual needs vary, most people require six to nine hours of sleep daily. The traditional eight hours of sleep is probably based on bodily needs, as indicated by the experience of the British North Greenland Expedition.

Throughout the perpetual night of the arctic winter, members of the expedition were allowed to sleep as much as they liked and at whatever hours they chose. It seemed as if they were sleeping excessively, but when actual hours of sleep were totaled, it was found that the men had averaged 7.9 hours a day (*Science News Letter*, 1956).

Warmth and Cold As Drives

Everyone everywhere is affected by the weather. Clothes, houses, sports, agriculture—and sometimes, it is said, even temperament—are affected by how hot or cold the climate is. No one can dispute the importance of man's drives to avoid excessive warmth and cold. But what is the physiological origin of these drives?

As we have seen, the senses of warmth and cold are mediated by separate sensory receptors. Some receptors in the skin are sensitive to contact with warm objects; others are sensitive to cold.

The temperature of the human body is regulated by a complex mechanism that balances heat loss against heat production. Thus two

temperatures are always involved: the amount of heat in the surrounding environment and the heat produced by the body itself. The body obviously can lose less heat to its surroundings on hot days than on cold ones. The hypothalamus, which responds directly to the temperature of the blood flowing through it, evidently plays a vital part in the adjustment of the body to heat and cold, as it does in the regulation of other drives.

When we feel cold—that is, when the external temperature falls below about 57 degrees—bodily activity is stimulated. Increased secretion of thyroxine and adrenaline helps bring about this increased activity. Increased muscular activity takes place; the blood pressure rises. Blood is driven from the surface of the body to the deeper tissues, where it will not be exposed to the cold. The reaction to heat is largely the opposite. When external temperature is raised, many bodily activities slow down. Perspiration helps cool the body surfaces. The blood vessels at the surfaces of the body dilate, thus exposing a greater volume of blood to the outer surfaces of the body for cooling. The circulation rate is increased to send blood through this “cooling system” faster. All these automatic changes act in various ways to keep the temperature of the body tissues at a fairly constant 98 to 99 degrees Fahrenheit, regardless of the temperature of the environment. Besides these continuous, automatic adjustments to warmth and cold, there are many things we do deliberately to keep our bodies at a comfortable temperature. Electric fans, air conditioners, ice water, lightweight suits, oil burners, hot drinks, and fur coats are all familiar results of man's drives to adjust to external warmth and cold. Such use of external sources is known as *servo control*, as distinguished from the automatic control involved in the internal changes described above (Hardy, 1955). Servo control behavior is not limited to human beings, for it has been shown that rats subjected to low temperatures will press a bar that turns on a heat lamp (Carlisle, 1964).

Evidently the servo control of temperature is also at least partly under the regulation of the hypothalamus.

Rats learned to turn on an infrared heat lamp by pressing a bar when the hypothalamus was cooled but

the temperature of the room remained normal (Satinoff, 1964). Conversely, animals in a cold room ceased to press the bar when the hypothalamus was heated, even though their blood temperature was quite low (Carlisle, 1965).

The Sexual Drive

The sexual drive is second only to the hunger drive in its implications for social living. While our society as a whole does not place many elaborate restrictions upon the food-taking behavior of its members, sexual expression is very closely governed both by law and by firmly rooted social conventions. Because our social structure limits an individual's sexual behavior, awareness of the sex urge is more persistent and more insistent than that of other drives which are not so likely to go unsatisfied. The typical college male, unlike the subjects in the Minnesota studies of semistarvation, shows little interest in cookbooks but gets much pleasure from *Playboy*. The conflict between the sexual drive and the cultural restrictions on its expression makes sex one of the most powerful forces influencing human behavior. Although sexual activity is necessary to the survival of the race, it is not essential to keeping an individual alive as are most other biological drives.

Scientists are still trying to find the exact location of the internal controls of the sexual drive. They know with certainty that the intensity of the sexual urge is in part dependent upon chemical substances circulating in the blood. Observations of both lower animals and human beings show that the strength of the sexual drive is profoundly influenced by the presence or absence of certain hormones produced by the testes in the male and the ovaries in the female. But at the human level social and emotional factors and past learning also play a large role in determining both the strength of the sexual urge and the manner of its expression.

The sexual drive in the male. As you recall from our discussion of the endocrine glands in Chapter 3, the sexual development of the male is steered by (1) the *androgens*, which are hormones secreted by the testes, and (2) certain

"middle man" hormones secreted from the pituitary body. The latter influence sexual development by stimulating the adrenal cortex, which in turn secretes a hormone that accelerates sexual maturation.

Sexually immature male cats will show typically male sexual behavior when given the male hormone testosterone, and female sex behavior will be elicited when stilbestrol (a synthetic female sex hormone) is given (Green, Clemente, and de Groot, 1957). This reversibility cannot be produced in sexually mature cats.

Certain drugs have been shown to have an effect on the sexual behavior of rats.

In one study seventeen male rats were each given four fifteen-minute tests, spaced at least two days apart. In each test the male was given two minutes alone in a cage; a female in full heat was then put into the cage with him. All males were tested once after being injected with caffeine (a stimulant), once after being injected with chlorpromazine (a tranquilizer), and twice after being injected with saline solution (no drug). Drug tests were alternated with no-drug tests.

Caffeine showed a stimulating effect on sexual activity on all the measures used; chlorpromazine had the opposite effect. During the no-drug session following administration of chlorpromazine, the animals showed more sexual activity than during the no-drug session following administration of caffeine. The investigators attribute this difference to differences in behavior learned while under the influence of the drugs, suggesting that under chlorpromazine rats had learned to make a more strenuous sexual response in order to overcome the depressant effects of the drug.

A further variable examined was rearing conditions. Eleven of the rats had been reared at least partially in isolation and some of these had previously been given electric shock when approaching a receptive female, while the other six had been reared normally. Additional rats (five favorably and three unfavorably reared) were also used as subjects to test this factor. Chlorpromazine had approximately the same effect on the animals reared in both sets of conditions, but caffeine had a stimulating effect only in the case of the animals reared under favorable conditions. It even produced a slight decrement in most measures of sexual activity for the unfavorably reared rats. The investigators felt this might indicate that caffeine acts by enhancing whatever behavior pattern is dominant in the situation for the individual under study (Zimbardo and Barry, 1958).

In mature male rats the occurrence of mating behavior is due entirely to the availability of a receptive female. Previous experience plays no part and the copulatory act is complete without prior experience (Beach, 1958). This "instinct" does not hold as specifically for any other observed species. In primates, as we shall see, certain specific infantile experiences are necessary to the development of normal adult sexuality.

In the normal adult human male the supply of androgens appears to be relatively constant, or at least fails to show the monthly periodic cycle characteristic of women. There is, of course, some fluctuation in the sexual drive as a result of general physiological conditions such as fatigue and also as a result of various psychological factors. Adult men who are castrated through accident or disease retain their ability to perform the sexual act, although there is usually some decline in the strength of the sexual drive.

The sexual urge in men reaches its peak in the late teens and starts to decline in the early twenties—at about the time the average middle-class male can consider marriage (Kinsey, Pomeroy, and Martin, 1948). The gradual falling off of the sexual urge is caused largely by a decrease in the quantity of androgens secreted. Social factors such as tiring of a particular sexual partner or becoming preoccupied with social, family, and economic interests can also operate to diminish the sexual urge (Beach, 1956).

All levels of the nervous system in man normally play a part in the integration of sexual behavior. In men whose spinal cords are severed, an erection of the penis can occur spontaneously but is not induced or accompanied by sexual fantasies; copulation, of course, is impossible, although ejaculation can be induced. On the other hand, men whose central nervous systems are intact can derive much pleasure from sexual fantasies even without erection, although this situation is much more common among old men than among men in the prime of life.

The sexual drive in the female. Both the glandular and the social bases of the sexual drive in the female are much more complex than those of the male. The primary sex glands of the female are the ovaries. These are responsible for

the secretion of the principal female sex hormones: the *estrogens*, which influence the sexual urge, and *progesterone*, which is important in pregnancy.

Estrogen secretion into the blood stream is greatest each month just before and after *ovulation*, when a mature egg cell is released down the *oviduct* ("egg conductor"), a tube leading from the ovary to the uterus. In the adult human female, ovulation usually occurs about halfway between two menstrual periods. Most medical experts believe that the brief time when the egg is in the oviduct or the uterus is the only time a woman can become pregnant; this period lasts only a few days during the month. It is difficult, however, to discount completely the evidence that in rare instances fertilization may occur at any time of the cycle, even during menstruation (Forbes, 1965).

The influence of the estrogens on the female sex urge is most clearly seen in the lower mammals. At ovulation, when the blood stream becomes enriched with estrogens, the female animal loses her previous indifference to the male and becomes highly receptive or even aggressively suggestive in her sexual behavior. This behavior is known as estrus, or "heat," and is a signal that the female animal is in a condition of readiness for pregnancy.

Despite their anatomical differences, the physiological responses of women during sexual activity are very similar to those of men. Respiratory and blood pressure changes, as well as orgasm, are essentially the same in both, and women can respond as rapidly as men. However, fewer substitutes for direct tactile stimulation are effective in arousing women: in one study, out of thirty-three kinds of such stimulation, including erotic stories and drawings, discussions of sex, and observations of sexual activity in animals, only three—seeing moving pictures, reading romantic literature, and being bitten (itself a form of physical stimulation)—affected as many women as men (Kinsey, Pomeroy, Martin, and Gebhard, 1953).

The most common cause of sexual maladjustment in women seems to be inadequate—or inaccurate—sex education. Girls who are taught prudish attitudes toward sex may come to feel that they should always deny any sexual feelings. Because their prejudice against sex has be-

come so ingrained, many women find it difficult to participate freely in sexual relations after marriage and so appear to their husbands as frigid, uninterested, and eventually uninteresting. This situation is often aggravated by lack of understanding or lack of consideration on the part of the husband, who may approach the sexual act in an abrupt manner that is frightening or distasteful to his partner. Either unpleasant sexual experience or fear of sex can make a woman psychologically frigid, even though she is perfectly healthy biologically.

Sex as a learned appetite. In both men and women, purely biological processes play only a partial role in sexual desire, rather than determining it almost entirely as in the lower animals. Hormones affect the sex desires of human beings to a much lesser extent than those of lower animals. In fact, some studies have found that women have greater desire immediately before and after the menstrual period than during the fertile period which corresponds to the "heat" of animals. Furthermore, treating frigidity or impotence with hormones is usually unsuccessful, since these difficulties are usually psychogenic in origin. Nor can differences in hormone concentration account for homosexuality, as studies of patterns of homosexual and heterosexual behavior show.

Considering such facts as these in conjunction with data on differences in childhood sexuality in different cultures with varying degrees of permissiveness, one psychologist has advanced the theory; based on extensive analysis of studies of human sexual behavior, that sex is largely a learned appetite rather than an innate drive (Hardy, 1964). According to this theory, sexual appetite grows with experience. It does have a physiological base, in that stimulation of the genitals is innately pleasurable and orgasm intensely so, but many nonlustful motives contribute to participation in sexual activity.

In our society the child is restrained from engaging in much sexual activity but after puberty is encouraged to show interest in members of the opposite sex. As a dating couple hold hands and sit close together, the pleasurable feelings which they experience reinforce their hand-holding behavior. This can hardly be a purely biological phenomenon, since holding the hand

of another person not perceived as an appropriate sex partner does not produce the same effect. Instead, holding hands with the appropriate person is part of a learned pattern of behavior. It is symbolically significant to the individual and may indeed be a symbol of status when the partner is highly regarded by the adolescent peer group. Thus the original hand-holding motive is often nonsexual in nature—hand-holding is the thing to do in a given set of circumstances. When it is reinforced, it continues and other behaviors, such as kissing, tend to be added to it. When these are reinforced by pleasurable feelings, more venturesome embracing or petting may be tried for a greater thrill. At some point true sexual arousal (lust) will occur, bringing a desire to repeat the powerful excitement it causes.

It is important to note that as new sexual activities are engaged in, new sets of associations are formed and more and more cues come to be associated with sexual desires. Thus reading about love or seeing erotic movie scenes can arouse sexual feelings, as they could not have done during childhood. According to this theory, lust can be controlled during the premarital period primarily by emphasizing a variety of nonsexual activities in the dating-courtship pattern and thus preventing the recurrent arousal of greater and greater sexuality. It also holds out the hope that the sexually incompatible married couple can, over a period of time, achieve greater harmony, since their desires are not irresistible drives but appetites which can be varied and adjusted.

Pain As a Drive

Localized pain of brief duration is not, properly speaking, a drive. For example, if you touch a hot iron accidentally, you draw back your hand. This is a simple, specific, involuntary response—the *withdrawal reflex*. But suppose that even after you have withdrawn your hand the burn continues to smart and you put a salve on it. Here pain is serving as a drive. Pain serves most effectively as a drive when it is prolonged and can be escaped by appropriate action.

Pain has important biological significance in that most harmful situations produce pain as

well as injury. Therefore, in seeking to avoid pain we also tend to avoid being injured. The drive to avoid pain has been an important motivating force in the history of mankind. One example of its effects is the search for better anesthetics.

To a greater extent than is true of some of the other biological drives, pain is closely related to the general emotional setting in which it occurs. Most neurotics react more vigorously to pain—and react to weaker pain stimuli—than do well-adjusted individuals. Mentally ill persons who have lost touch with reality, on the other hand, are far less responsive to pain stimuli than normal persons (Hall, 1953).

Bowel and Bladder Tensions

When the bladder and lower colon become distended, receptor cells in their walls are stimulated and produce drives which are satisfied by urination and defecation. These drives usually have little significance in adult motivation, since obstacles to their relief are seldom imposed. In early childhood, however, they play a very important role in motivation, particularly during the period of toilet training. Mothers in our culture are proud when their children become able to stay clean and dry; hence they sometimes tend to overemphasize toilet habits or to start training too early. Because the muscles that control the bladder and bowels are among the last to come under the child's control, and because he derives primitive enjoyment from relieving the tensions caused by accumulated wastes, he finds it doubly frustrating to be punished for soiling himself when he is too young to achieve control.

Too early or too severe toilet training may thus induce a feeling of insecurity in the child. In some cases the child also learns to use his excretory functions as a means of dominating or at least annoying his parents. If he sees that they are unduly concerned with his control, he may gain a feeling of power by withholding bowel movements until an inappropriate time. Such problems may usually be avoided if parents wait until the child is physically ready, do not exert too much pressure on him, and praise him for successes.

The Need for Contact Comfort

Harry F. Harlow, a psychologist who has worked extensively with monkeys, noticed that baby monkeys made affectionate responses to the cloth pads on the floor of their cages, much as human infants often become strongly attached to a particular blanket, scarcely relinquishing it long enough for it to be laundered. He decided to explore further this apparently inborn need for contact with something soft and warm, particularly in relation to the need for food. In a series of experiments macaque monkeys were separated from their mothers at birth and placed with artificial mothers.

A substitute mother made of wood covered with sponge rubber and terry cloth and a wire mother of similar size and shape were placed in the infants' living cages. Half the monkeys could obtain food from a bottle attached to the cloth mother, the other half from the wire mother. All of them were free to go to either mother at any time, and the amount of time spent with each mother was recorded automatically.

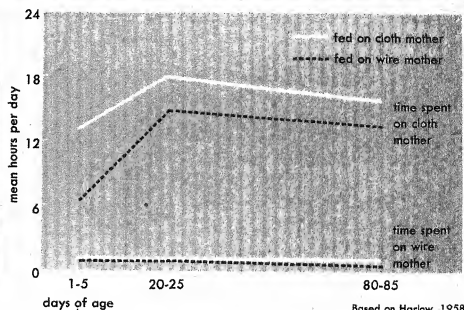
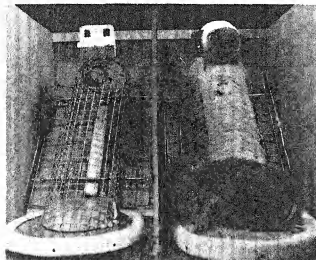
With increasing age and opportunity to learn, time spent with the lactating wire mother decreased and time spent with the nonlactating cloth mother increased. Thus contact comfort completely overshadowed nursing in determining which mother was preferred. Furthermore, when a fear stimulus (a toy bear beating a drum) was introduced, the monkeys consistently sought the cloth mother, regardless of which mother gave milk.

Open field tests confirmed this reaction. Twice a week for eight weeks each monkey was put into a room containing many stimuli known to produce curiosity-manipulative responses in baby monkeys, a cloth diaper always being one of the stimuli. The cloth mother was present on alternate occasions. After one or two adaptation sessions the monkeys would rush to the mother and clutch her, using her as a base of operations and a source of security, exploring one stimulus and returning to her before going to explore another. When the cloth mother was absent, they would often freeze in a crouched position or rush to the mother's usual position and then run from object to object screaming and crying. Although they often clutched the diaper, it never pacified them. Again cloth-fed and wire-fed monkeys behaved alike.

The monkeys were then separated from their mother substitute and were tested for affectional retention daily for the first nine days and at thirty-day intervals for five

THE IMPORTANCE OF CONTACT COMFORT

The baby monkeys nestled close to the cloth mother and spent little time near the wire one, regardless of which one gave milk.



months, by means of open field tests. On these occasions they spent their time on the mother and did not explore other objects, except that occasionally they would bring a folded piece of paper to the mother. When the mother was absent, they at first behaved the same as in early tests but gradually overcame their fear and became adapted to the open field situation. When the mother was covered by a clear plastic box, they were initially disturbed but much less so than when she was absent, and they still used her as a base of operations. The affection of the monkeys for their cloth mothers showed no decline throughout the period.

Four control monkeys had cloth and wire mothers attached to their cages for the first time at the age of 250 days (after weaning). All screamed and tried to escape. However, within forty-eight hours they began to explore and after ten days were spending about nine hours a day on the cloth mother, even running to her when frightened. They came to use her as a base of operations in field tests, but they never rushed to her as did those who had had her from the beginning. Less than half an hour a day was spent with the wire mother (Harlow and Zimmerman, 1958).

These studies appear to indicate an inborn drive for contact in monkeys, independent of

satisfaction of the hunger drive. That this drive is somehow related to the development of normal sexual patterns is shown by the later behavior of the monkeys in these experiments. Male monkeys reared on wire and cloth mothers did not, as adults, engage in mating behavior. Female monkeys reared in this way showed no interest in mating behavior at all. When finally made pregnant by persistent males, they ignored or were abusive of their offspring, though with second and third pregnancies their maternal behavior was improved.

Biological Drives As Homeostatic Mechanisms

Though they vary in intensity, all the biological drives are regulatory mechanisms that help maintain the physiological equilibrium of the individual. An organism will go to remarkable lengths to maintain the constancy of its normal internal environment. This process, as we have seen, is called *homeostasis*.

Biological drives originate in physiological conditions which have disturbed the organism's

equilibrium. When an internal state is disturbed, conditions are produced that motivate the organism into seeking activity. Such activity ceases only when the goal is attained and biological equilibrium is restored or when a stronger motive takes precedence—as when you stop in the midst of preparing a midnight snack to investigate the smell of smoke.

Many homeostatic activities are largely internal and automatic. Among these are the maintenance of constant body temperature and of the proper balance of oxygen and carbon dioxide in the blood stream. Another, related to nutrition, is the very complex process by which the body maintains a constant level of sugar in the blood stream.

But biological needs can never be satisfied permanently, and complex higher forms of activity have developed—particularly in man—to meet the problem of recurring disturbances in tissue constancy (Stagner, 1951). The organism reacts to very small physiological changes as cues to a change in its equilibrium and thus can anticipate many of its needs. Animals build nests and hoard food for winter use. Man not only has learned to eat before hunger pangs be-

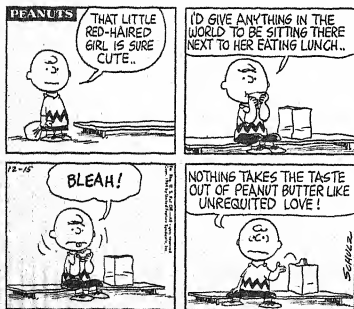
gin but has developed elaborate systems of agriculture, food preservation, storage, and commodity exchange in order to ensure an adequate food supply at all times.

Thus homeostasis is more than the automatic maintenance of chemical conditions of the body in response to specific stimuli. It involves an active effort of the organism to establish a physical environment that is as constant as possible. Many of man's needs also require the maintenance of a relatively stable social environment.

Homeostasis does not account for all types of behavior, however, even at the physiological level. An organism may occasionally behave in a manner detrimental to bodily maintenance. For example, human babies, if given the chance, may eat enough salt to kill themselves. Also the human body is without means of protecting itself against certain harmful conditions, such as too high a level of radiation in the environment. Thirdly, an organism sometimes strives for goals that have no significance for adaptation. Rats that are not thirsty will learn to thread complex mazes when rewarded only by water sweetened with saccharine, a substance that, though harmless, is not required in the body chemistry. This, of course, could be a conditioned response built in as a result of tasting sugar, which is needed. Or it could be that the animal organism is set or "programed" at birth to seek sweetness. Homeostasis is a valuable concept, but it does not seem to tell the entire story (Davis, 1958).

It has been suggested that many of the psychological motives which we shall examine in the remainder of the chapter operate as homeostatic mechanisms in much the same fashion as biological drives, motivating the individual to create and maintain a physical and social environment in which his needs for love, for security, for approval, for prestige, for experience, for knowledge are satisfied. His self concept acts as another "constant state" which the healthy person seeks to preserve, much as he seeks to preserve the various tissue constancies (Stagner, 1951).

On the other hand, striving for adventure, greater knowledge, or social reform often means an increase in tension and discomfort and a disruption of the "constant state." Sometimes



● The importance of psychological motives, as well as the close interdependence of biological and psychological motivation, is readily seen in the way re-buffs or worries can suddenly lessen the urgency of physiological drives and change the attractiveness of biological reinforcers.

men choose death rather than dishonor, put love of country above personal safety, and prefer esthetic or religious experience to the

satisfaction of their hunger, thirst, or sexual drives. So again we see that homeostasis is evidently not a universal principle.

PSYCHOLOGICAL MOTIVATION

Biological drives have a direct physiological basis. They are fundamental. But obviously there are many other forms of human motivation. What is the relationship between physiological needs and such motives as man's curiosity about the world, his political and religious beliefs, his capacity to hate and to love, his patriotism, and his ambitions to make money and gain prestige? In many ways these complex psychological motives are more significant to man than his biological drives. *

Man seems to have certain basic psychological needs which he expresses through the social patterns of his particular culture. He needs security, he needs to respond to others through the exchange of love and esteem, he needs to accept himself and at the same time to strive to better himself, he needs to seek new experiences, he needs to be accepted and approved by those around him. Although these needs are sometimes overwhelmed by other needs and by obstacles in the environment, their satisfaction is nonetheless essential to the individual's healthy development. Psychologists have learned that frustration of man's psychological motives—while it does not lead directly to death as does prolonged frustration of most biological drives—can eventually result in emotional disturbances or even in physical illness. In speaking of motivation as physiological or psychological, therefore, we must always remember that there is no strict separation between these categories.

Although certain basic psychological needs (for example, the needs for security and for social approval) seem always to be present, the manner in which they are satisfied depends upon the individual's environment and also

upon his particular stage of physical, social, and emotional development. An individual's motivational pattern becomes increasingly complex as his experience widens. The adult has many motives as a spouse, parent, or wage earner, for example, that he did not have as a child. Two attempts to categorize adult human needs and motives are summarized on page 396.

The importance of certain psychological needs to the individual's health as well as his happiness—together with the fact that such needs are found in people of widely different cultures—has led some psychologists and anthropologists to speculate that these may be in-born rather than acquired, though the forms in which they are expressed are clearly learned. Research has been far from sufficient to establish such a theory, although studies with animals give some evidence for at least one innate psychological drive—curiosity.

Curiosity—the Need to Investigate

An important motive that is apparently in-born or learned early without formal training is curiosity. As early as 1881 it was observed that monkeys would tirelessly investigate their surroundings and manipulate any new object, although no reward was to be gained except the sheer fun of it. One monkey worked for two hours (unsuccessfully) trying to open the lock of a trunk in which nuts were stored, although a plentiful supply of nuts was within easy reach (Romanes, 1881).

Thomdike (1901) reported the case of a monkey who repeatedly struck a projecting wire, apparently just to make it vibrate.

CLASSIFICATIONS OF HUMAN NEEDS AND MOTIVES

There have been many attempts to classify human needs and motives. One classification identifies three categories of needs (Prescott, 1938):

Physiological	Needs for essential materials and conditions, for a certain rhythm of activity and rest, and for sexual activity
Social	Needs for affection, belonging, and likeness to others
Ego-integrative	Needs for contact with reality, harmony with reality, progressive symbolization, increasing self-direction, a fair balance between success and failure, and attainment of selfhood

Another classification lists fifteen "manifest needs" as being present in varying strengths in everyone (Edwards, 1959).^{*} These items were derived from an earlier list developed from responses to the Thematic Apperception Test, which was discussed in Chapter 4:

Achievement	To do one's best, to be successful, to accomplish tasks requiring skill and effort, to be a recognized authority, to accomplish something important, to do a difficult job well
Deference	To get suggestions from others, to find out what others think, to follow instructions and do what is expected, to praise others, to accept leadership of others, to conform to custom
Order	To keep things neat and orderly, to make advance plans, to organize details of work, to have things arranged so they run smoothly without change
Exhibition	To say clever and witty things, to have others notice and comment upon one's appearance, to say things just to see the effect upon others, to talk about personal achievements
Autonomy	To be able to come and go as desired, to say what one thinks about things, to be independent of others in making decisions, to do things without regard to what others may think
Affiliation	To be loyal to friends, to participate in friendly groups, to form strong attachments, to share things with friends, to write letters to friends, to make as many friends as possible
Intracception	To analyze one's motives and feelings, to understand how others feel about problems, to judge people by why they do things rather than by what they do, to predict others' behavior
Succorance	To have others provide help when in trouble, to seek encouragement from others, to have others be kindly and sympathetic, to receive a great deal of affection from others
Dominance	To argue for one's point of view, to be a leader in groups to which one belongs, to persuade and influence others, to supervise and direct the actions of others
Abasement	To feel guilty when one does something wrong, to accept blame when things do not go right, to feel that personal pain and misery do more good than harm, to feel timid and inferior
Nurturance	To help friends when they are in trouble, to treat others with kindness and sympathy, to forgive others and do favors for them, to show affection and have others confide in one
Change	To do new and different things, to travel, to meet new people, to have novelty and change in daily routine, to try new and different jobs, to participate in new fads and fashions
Endurance	To keep at a job until it is finished, to work hard at a task, to work at a single job before taking on others, to stick at a problem even though no apparent progress is being made
Heterosexuality	To engage in social activities with the opposite sex, to be in love with someone of the opposite sex, to be regarded as physically attractive by those of the opposite sex
Aggression	To attack contrary points of view, to tell others off, to get revenge for insults, to blame others when things go wrong, to criticize others publicly, to read accounts of violence

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Thorndike states, "He did not, could not, eat, make love to or get preliminary practice for the serious battles of life out of that sound. But it did give him mental food, mental exercise. Monkeys seems to enjoy strange places; they . . . like to have feelings [as much] as they do to make movements. The fact of mental life is to them its own reward." But after this early work psychologists neglected the study of curiosity, and a period of over forty years passed before systematic investigations of curiosity were resumed.

Even during the first day or two of life, monkeys show visual curiosity and exploration, starting at objects placed outside their cage and trying to reach them although the monkeys cannot discriminate visual detail at this age. This curiosity is unquestionably innate. About the tenth day of life the baby monkey starts locating the nipple of his nursing bottle by vision instead of by contact with his cheek. At this same age he suddenly develops the ability to learn discrimination problems—to tell the difference between triangles and circles, between horizontal and vertical stripes, and so on. Furthermore, he now begins to show a strong need to explore his world visually (Butler and Harlow, 1954). This, in turn, leads to manipulation, which becomes an exceedingly powerful motive. Indeed, the monkey cannot seem to stop manipulating and will play with whatever is available.

This visual curiosity and need for manipulation, once it has appeared, is never lost. Both wild and caged monkeys spend a large part of their time in such activities. It is particularly interesting to note that this motive precedes the need to eat solid food and in fact is essential to the latter. When first given bits of solid food by monkeys play with them and manipulate them as they would toys. They first place them in their mouths as a form of exploration. Many days may pass before a piece of food is actually eaten in this process.

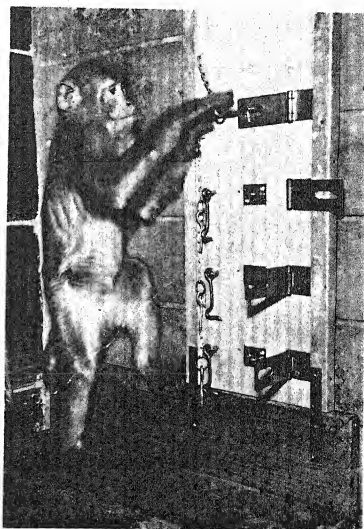
'prob-
perform-

ed to discriminate
A test board with
number of screw eyes

Monkeys readily learn various kinds of discrimination problems. In one experiment monkeys learned by the mother to discriminate between two colors of screw eyes to learn his way out of a box presented to them, in which a punishment upon her.

been placed. The red eyes could be removed, but the green ones could not; the monkeys learned to remove all the red eyes without touching the green ones. In this and six other problems involving different paired colors of screw eyes, the monkeys showed progressive improvement, with no decrease in their motivation throughout the study. Rest periods prevented satiation or boredom with the problem, but such rewards as food were unnecessary to stimulate learning (Harlow and McCleary, 1954). Indeed, an earlier study showed that food rewards may actually disrupt learning (Harlow, Harlow, and Meyer, 1950).

Even the lowly rat exhibits a phenomenon that may be regarded as curiosity, or at least as a desire to explore for the joy of exploring. In an early experiment domestic rats showed themselves willing to cross an electrified grid



▲ Monkeys readily learn to unhook hasps on apparatus such as this even when no reward is given by the experimenter for successful performance.

to explore a maze. This led the experimenter to postulate an inherited exploratory drive (Nissen, 1930). More recent studies confirm the fact that maze learning will occur readily in the absence of food and drink as extrinsic rewards, indicating that maze exploration is in some way rewarding in itself.

In one study fifty male albino rats were fed intermittently throughout the experiment. Part of them were trained to press a bar which would open a door enabling them to go from a white compartment into a black one. Others were trained to go from the black to the white compartment. A third group were placed in the white compartment, but although the bar-pressing response would open the door they were prevented from seeing or going into the black compartment by a panel immediately behind the door. Both the groups which were allowed to explore learned the bar-pressing response. (The black-to-white group learned faster, indicating some preference on the part of the subjects for white over black.) The group that did not have the reinforcement of seeing and/or exploring the black compartment did not learn (Myers and Miller, 1954).

Another pair of investigators have made use of wild mice in complex maze systems intermediate between the ordinary simple laboratory maze and their natural habitat. Here again the animals explore and learn exceedingly complex mazes without the use of food or water as an incentive. Very little exploration occurs, however, when the mice have access to activity wheels. These results indicate that while exploration is self-rewarding, mice also seek activity for its own sake (Brant and Kavanau, 1964).

The Need to Achieve

One of the psychological motives seen in man but not in lower species is the need to achieve. The need for achievement is defined operationally as behavior which shows effort to do one's best, to do better than others, or, in general, to accomplish something.

One psychologist postulates an innate motivation toward competence in relation to the environment (White, 1959). Innate or not, it is not surprising that children reared in a typical American home develop a need to achieve.

The notion that success comes to the one who works hard is part of the American way of life. Parents reward their children for learning new skills and for not being quitters—for sticking to the task until it is accomplished. For children brought up in such an environment, the need for achievement becomes a strong one.

The achievement need was first defined largely upon the basis of subjective clinical methods of observation (Murray, 1938). Its existence as a sharply defined unique trait has not been verified by the statistical method of factor analysis (Guilford, 1959). Rather, factor-analytic work suggests that it might be more appropriate to speak of "achievement needs." Several other so-called "basic psychological needs" postulated by early workers have not received objective confirmation.

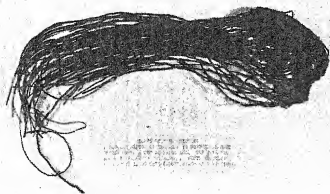
As we have seen (p. 132), man's motivation to achieve has been subjected to intensive study by a group of Harvard psychologists.

The primary aim of these studies was to learn something about the origin of the achievement motive by determining whether individuals with high and low need for achievement had been treated differently while they were growing up. The experimenters found that, in general, college students with a high need for achievement tended to perceive their parents as relatively distant rather than close, whereas students with a low achievement need described their parents as more friendly and helpful. Similarly, students with a high achievement need perceived themselves as more independent of authority in general than did those with a low need for achievement and, in fact, showed themselves to be more independent in their judgments and less inclined to conform to group opinion.

The same investigators compared the development of the achievement need in different cultures. It was found that the age at which training in independence was begun and the severity of training in independence correlated quite significantly with the value placed on achievement in the folk tales of each culture. Initial d, to work hence in training showed an inverse relationship to even though ment need (McClelland, Atkinson, Clark, and the opposite sex).
 tractive by those

tell others off, for culture, differences in the attitudes publicly, to react toward independence training
) * Adopted by permission to be related to the strength
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 01 achievement in their sons.

◆ To us, elephant tail bristles look worthless and paper money valuable and appealing. Yet one is inherently as worthless as the other. Fifty years ago in Portuguese West Africa an elephant tail would buy two slaves; fifty bristles were worth about \$1.50 at that time. We see the paper money as having value because it has been associated many times in our experience with pleasure and the satisfaction of needs.



The achievement need of a group of twenty-nine eight- to ten-year-old boys was measured, and their mothers were asked to fill out a questionnaire indicating what accomplishments they expected of their sons at various ages. The mothers of the boys with a high achievement need expected over 60 per cent of the accomplishments listed to have been met by the age of seven, whereas the mothers of those with low achievement need expected only about 33 per cent to be met by that age.

There also was a clear-cut difference in the kinds of demands emphasized by the two groups of mothers. There was little difference in the age at which they expected their sons to be able to do such things as eat without help or put away their possessions—things which the child often is urged to do as an aid to the parent. The boys with a high need for achievement, however, were expected earlier to know their way around their part of the city, to try new things for themselves, to do well in competition, and to make their own friends (Winterbottom, 1953).

These demands seem to reflect an interest in the welfare of the child himself and a desire to help him develop true independence, as opposed to a primary concern for the parent's own convenience. Such demands also indicate a greater faith in the child's ability to master situations on his own than is shown by the mother who does not expect her child to learn his way about but keeps him dependent upon her by

restricting him to his own house and yard until a later age.

In general, these studies indicate that the need for achievement is learned. The child seeks to overcome the anxiety created by his parents' demands and to avoid their disapproval by working hard to achieve the independent action they require. As the years pass, achievement is rewarded many times, and eventually the child's need to achieve by his own effort becomes autonomous, acting as a powerful motivating force in many areas of life. It may even become so strong as to be disruptive if the individual becomes anxious over possible failure to achieve.

The Power of Symbolic Rewards

Many of the things we strive for are things we have *learned* to want. ◆ The way in which neutral objects can come to act as rewards as a result of learning can be seen in the training of a dog. By being petted at the same time he is praised and by being whipped while being scolded, a dog comes to react to kind or harsh words in the same way he originally reacted to the petting and the physical punishment. Words have become symbolic rewards. It should be readily seen that the sequence of events here is what we studied in Chapter 6 as

conditioning and that the master's words are secondary reinforcers.

In one series of experiments demonstrating learned rewards chimpanzees were trained to attach value to poker chips or tokens which they received in "payment" for performing various tasks. The animals were taught to insert the tokens into vending machines which yielded some primary reward like a grape or a raisin for each token inserted. Once the reward value of the tokens had been learned, the chimpanzees were taught a series of complicated tasks in which they were rewarded only with a token for each correct response. The fact that the animals readily learned these tasks demonstrated the reward value they attached to the poker chips as a result of previously associating them with the primary reward of food (Wolfe, 1936; Cowles, 1937).

Human beings learn early in infancy to attach value to formerly neutral objects. Babies

learn to react to voices and eventually to specific words as representing or suggesting the satisfaction of their bodily needs. All through infancy the child hears his mother's voice murmuring affectionately as she responds to his crying and relieves him of pain, wetness, hunger, and thirst, or gives him the pleasurable sensations of being fondled and caressed. The presence of a person whose behavior is associated with pleasure or release from pain and discomfort is called a social reward. "In the first year of its life," it has been pointed out, "the human infant has the cues from its mother associated with the primary reward of feeding on more than 2000 occasions." (Dollard and Miller, 1950, p. 91)

Whether social rewards are innately reinforcing or entirely learned we do not know, since no human infant has ever been reared and observed in the absence of opportunity to learn. It has been demonstrated, however, that infants as young as three months of age can be conditioned with no reinforcement other than social rewards.

The subjects were twenty-one three-month-old infants living in an institution. Their vocalizations were tallied by an observer during nine three-minute periods spaced throughout the day for six days. During the first two days the experimenter bent over each subject with an expressionless face while the vocalizations were tallied. During the next two days, the conditioning period, she rewarded each vocalization by smiling, saying "Tch, tch, tch," and touching the baby's abdomen. This social reward increased the vocalizations of eighteen of the infants—significantly for fourteen of them. Two extinction days followed, during which the experimenter again remained expressionless and did not reinforce vocalizations. The rate of vocalization dropped to approximately what it had been during the first days (Rheingold, Gewirtz, and Ross, 1959).

As the child grows older and starts to play with other children, it sometimes happens that he is hurt by some plaything or is bullied by an older child. Here the mother sets things right, at the same time speaking words of love and sympathy. Again the mother's voice gradually comes to take on the same sort of reward value as purely physiological relief. In this way many words and objects which cannot themselves sat-



■ This chimpanzee has learned that the "Chimp-o-mat" will dispense food when he inserts a poker chip into the slot. Therefore, although poker chips would normally have little or no value for him, they have taken on a symbolic value, and he will readily learn complex tasks if he is rewarded with this form of "spending money."

isfy biological drives come to be associated with real rewards, until they eventually acquire a reward value of their own and come to be sought for their own sakes.

Rewards of this kind are also called *symbolic rewards*. They are sought by all socialized human beings. Slowly at first, then more rapidly as he becomes increasingly aware of other people, the child acquires a growing store of effective symbols. Certain objects, sounds, and reactions of others become associated—with varying degrees of closeness—with the satisfaction of his basic needs and eventually come to be sought for themselves.

Through a similar learning process the organism can be motivated to avoid words and objects which have come to be associated with some painful experience. Studies with animals have demonstrated clearly the motivational power of acquired fear (Miller, 1948). In the next chapter we shall examine the manner in which fears can be learned.

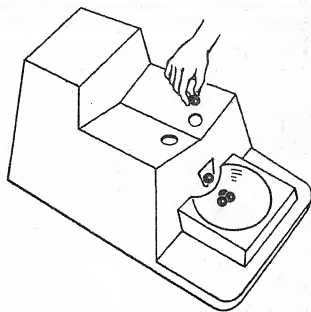
The reinforcing power of different symbolic rewards was compared in a study using human subjects.

The subjects, seventy-eight psychology students and the same number of neuropsychiatric patients, were presented with a series of cards on which six pronouns and a verb were printed. Their task was to make up a sentence using one of the pronouns and the verb. Sentences using "I" or "we" were reinforced either by cigarettes or candy, by poker chips, or by the experimenter's saying "Good." For both groups of subjects the verbal reinforcement and the cigarettes or candy proved effective in conditioning; the poker chips did not. Extinction occurred more rapidly with the college students. (Buss, Gerjoy, and Zusman, 1958).

Like primary rewards, symbolic rewards have been found to be more effective after a period of deprivation.

In an experiment using 102 first- and second-grade pupils as subjects, the task or "game" was to place marbles in either of the two holes in a simple toy. [®] Before beginning the game, subjects in one group (Deprivation) spent twenty minutes in social isolation, while the experimenter "searched" for the toy. Those in a second group (Nondeprivation) began the game immediately; those in the third (Satiation) spent twenty

● A simplified drawing of the apparatus used in the Gewirtz and Baer study.



minutes drawing and cutting out designs, with the experimenter constantly approving and admiring their efforts. The game then started, with four minutes of unreinforced play, followed by a conditioning period during which the experimenter used such words as "Good," "Fine," or simply "Mm hmm" as reinforcers whenever the subject dropped a marble into the hole that had been selected least often during the fourth minute. This approval functioned as a reinforcer after all three conditions, increasing the frequency of the response. However, it was most effective following the Deprivation condition and least effective following Satiation (Gewirtz and Baer, 1958).

As we saw in Chapter 7, conditioning can be established with a symbolic reward like "Mm hmm" even when the subject is unaware of the exact response for which he is being rewarded. When subjects are simply asked to say all the words they can think of during a specified interval, a response of "Mm hmm" by the experimenter to words in a specific category increases the number of words in that category given (Greenspoon, 1955; Dulaney, 1961).

When such rewards are introduced in the more complex conditions of ordinary conversation, such conditioning does not seem to take place among college student subjects (Sullivan

and Calvin, 1959). In one study, however, some conditioning was observed among a group of patients undergoing psychotherapy (Caruth, 1961).

Even in infancy a child learns that parental approval goes with certain kinds of behavior and disapproval with others. He soon finds that when he does the "right" thing he receives the rewards—if only verbal—that go with approval; when he does "wrong" he receives disapproval and may be punished. He comes to think of things as "good" or "bad" according to his parents' reactions, and if he has a good relationship with them, his behavior comes to be motivated by a desire to conform to their standards.

The very words used by parents in different cultures tend to foster different values. When the American mother would say, "Be good!" the French mother says, "Be wise," the German says in effect, "Get back into line," the Scandinavian says, "Be friendly," and the Hopi Indian says, "No, that is not the Hopi way" (Sinclair, 1954b). Thus the child may learn to judge the desirability of his behavior primarily in terms of whether or not it is prudent, or whether or not it is considerate and helpful, or whether or not it conforms to society's demands. The difference, of course, is one of emphasis, since all these standards may be used in evaluating behavior. The traits encouraged by social approval on one South Sea island are illustrated on page 403.

The mother's or father's words and tones often check the child from doing things he very much wants to do. Conversely, words and tones of approval may sometimes be connected with things that he does not want to do—in our society, perhaps setting the table or clearing the sidewalks of snow. It usually happens, therefore, that the individual begins to experience some degree of conflict over this matter of approval and disapproval, especially if he must give up his own sense of autonomy in order to gain the approval of others. Sometimes this conflict results in *negativism*—it is as if the child has learned to want the things forbidden and to be averse to the things for which he is praised. Unwise parents sometimes destroy much of their child's tendency to seek social approval by demanding too often that he sacrifice his own inclinations.

At first, symbols of social approval are important to the child only when they come from his parents or from someone else close to him who satisfies his needs. Gradually, however, he comes to desire the approval of society as a whole—or at least of the particular social group to which he belongs. The stock of symbolic ideas, words, and objects that motivate his behavior grows to include the symbols that abound in social life: flag, slogans, principles of political or social reform, philosophical ideals. Each culture supplies its own stock of such symbols. These vary greatly but in each case exert a profound influence on the individual's pattern of motivation.

Among the Arapesh, a primitive tribe living in the mountains of New Guinea, it was found that infants were cherished and protected and were fed whenever they were willing to eat, even though they showed no signs of hunger. Throughout childhood an attitude of passive acceptance of food and other requirements was fostered. As a result, the mature Arapesh observed were a gentle, cooperative people, interested chiefly in growing things, and seldom showing aggressive behavior, even though life was difficult and food hard to obtain in their rocky environment.

In contrast, among the Mundugumor, a neighboring tribe, infants were carried in harsh baskets that scratched their skins. They were nursed only until barely satisfied, which caused them to suck aggressively and to develop a basically angry attitude toward life. Formerly headhunters, the men of this tribe spent most of their time preying on their neighbors. The women were almost as aggressive and tended to dislike the role of mother. They provided most of the food supply, leaving the men free to fight (Mead, 1949).

Adjustment to social requirements is a vastly different thing among the Mundugumor than it is among the Arapesh, and vastly different social motives are acquired in early life. In either case, however, individuals strive to satisfy their social needs for security and approval as well as their biological drives.

Investigators studying the relative effectiveness of praise and blame in relation to level of general intelligence in motivating performance on a discrimination task among high-school students have discovered an interesting interaction.



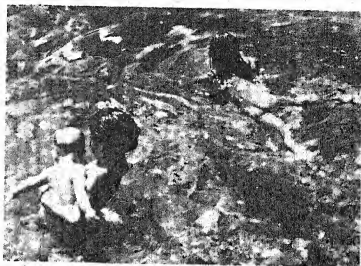
A study by two social anthropologists, Joseph Weckler and Conrad Bentzen, demonstrates how social approval induces the desired behavior in a culture quite different from ours. The people of Mokil live on an isolated atoll with an area of less than one-half square mile and a population of 425, located in the Caroline Islands of Micronesia. The Mokilese live in intimate contact with each other and with nature. Their culture teaches them early in life to work and play in cooperating groups and not to expect or want privacy.

On Mokil, as elsewhere, adult-child relationships are basic to the child's formation of attitudes. The infant is fondled and indulged; parents, other adults and children of the family, and even visiting friends, hold him on their laps and carry him astride their hips. There is no set bedtime, and he is given the breast whenever he cries or indicates hunger. Even if his mother is busy at some task, he may crawl into her lap and nurse without reproof.

When the child is about three, however, the mother suddenly ceases her indulgence, forcibly weans him, and turns him over to the care of older children for much of the day. The common result is temper tantrums. The mother's response is to slap the child, to throw rocks at him, or even to toss him into the lagoon. The child is thus forced to learn to spend most of his time with other children.

Older children cheerfully take younger siblings wherever they go. Consequently many babies, without instruction, learn to swim before they learn to walk. Children learn group cooperation and sharing from their older playmates. If a child obtains some delicacy he invariably shares it with his friends.

The emphasis on group cooperation and sharing persists throughout life. It is essential in many tasks like reroofing a canoe house. Every family donates thatch and the labor of one or more men so that another family's roof can be re-covered quickly. Marked preference for group activity is shown even when it affords no economic advantages. Women weaving mats for household use or for sale take their materials to a common place where several women can work together in preference to working at home alone.



Half of the ninety-six subjects had a mean IQ score of 138; the other half averaged 101. The task was to indicate which pattern was different in a series similar to the one shown here.



After the first trial, consisting of thirty-two stimulus presentations, half of each group were told that they had done poorly and that they would be given another chance to see if they could improve. The other half were told that they had done very well and were asked to do the cards again to see if they could equal their previous performance. Praise or blame made no significant difference in the performance of the more intelligent group in the second trial. However, those of average intelligence who had been in the blame group did show a significant decrement in performance on the second trial (Kennedy, Turner, and Lindner, 1962).

The Importance of Models

Normal child-rearing patterns offer numerous opportunities to learn imitative behavior. For example, in very typical play the mother of a baby points to her nose and says, "This is Mama's nose. Show me baby's nose," and rewards the child with a hug or a kiss for imitating her action in an even remotely accurate way. If the desired gesture is not forthcoming, the mother places her baby's fingers on its nose and then gives the reward. Imitative behavior on the part of the older child—dressing up like Mommy or imitating Daddy driving the car—usually meets with a favorable response from adults also. Thus the child gradually develops a great many patterns of behavior which are largely imitative in nature. Some of these can result in self-rewarding behavior patterns which will influence the individual's relations to other persons throughout life. Two behavior patterns of great importance in influencing our relationship with other people in daily living are *aggression* and *dependency*. The possible role of learning through *imitation* in building these traits of personality has been of special interest to psychologists.

The learning of aggressive behavior. Aggression is best defined as "a response that delivers noxious [hurtful] stimuli to another object or person" (Buss, 1961). Aggressiveness, though a common phenomenon, is not universal and varies greatly in both form and degree from one society to another. At one extreme is the head-hunting Iatmul tribe, who display extremely aggressive behavior, not only on the warpath but also in other aspects of tribal life. This is typified by the harsh initiation ceremonies to which Iatmul adolescents are subjected. During these rites adult warriors vie with each other in displaying cruelty, as described by an anthropologist who studied these people:

"In the first week of their seclusion, the novices are subjected to a great variety of cruel and harsh tricks . . . and for every trick there is some ritual pretext. And it is still more significant of the ethos of the culture that the bullying of the novices is used as a context in which the different groups of the initiators can make pride points against each other. One moiety of the initiators decided that the novices had been bullied as much as they could stand and were for omitting one of the ritual episodes. The other moiety then began to brag that the lenient ones were afraid of the fine fashion in which they would carry out the bullying; and the lenient party hardened their hearts and performed the episode with some extra savagery." (Bateson, 1936, p. 131)

At the other extreme are the Hutterites, a religious sect who emphasize personal responsibility and the control of impulses.

"No fighting or verbal abuse is permitted. A spirit of compromise, of giving in to one's opponent, is the accepted guide for interpersonal disagreements and frictions. It is expected that a Hutterite man will not get angry, swear, or lose his temper." (Kaplan and Plaut, 1956)

The Mundugumor and the Arapesh, described earlier, also provide a vivid contrast in aggressiveness. Clearly, then, aggressiveness is not innate.

Many studies have demonstrated that aggressive behavior is a typical reaction to frustration of a drive, and the role of frustration in leading to aggression will be examined more thoroughly in Chapter 13. It is now apparent, however,

that aggressive behavior can also be produced in the absence of any frustration. This may take place either through imitation of an aggressive model or through selective reinforcement for aggressive responses—or, of course, through a combination of the two. Thus the Latvian boys are constantly surrounded by adult patterns of aggression and their imitation of these patterns is rewarded and approved, while failure to behave aggressively is disapproved.

In the laboratory, both children and adults readily imitate aggressive models regardless of their personality structure and independently of whether there is any direct reward for such behavior, either to them or to the model they watch (Bandura, Ross, and Ross, 1963a; Walters and Llewellyn, 1963).

In one study, one group of children were shown a five-minute cartoon film portraying almost constant aggression of one human-like figure against another. A comparable group saw a five-minute cartoon film showing three bear cubs and a mother bear in pleasant play. Measures of aggressive responses taken before and

after the film viewing revealed a marked increase in such responses in the children who had seen the aggressive film (Löwaas, 1961).

The same results are observed whether the models are people or cartoon characters and whether they are seen directly or in a film. Boys display significantly more imitative physical aggression than girls, especially in response to an aggressive male model.

For some kinds of imitative behavior, the nature of the relationship between the model and the child affects the degree of imitation. For example, the sons of warm, affectionate fathers take the role of father in doll-play activities more often than do boys whose fathers are rather cold (Sears, 1953).

In the laboratory, too, it has been found that nursery-school children are more likely to imitate a model who has been helpful and affectionate than one who has been aloof and impersonal except in the case of aggressive responses, which are readily imitated in both cases (Bandura and Huston, 1961).



These pictures show two children's later imitation of actions seen in a film (left) in which a model kicked an inflated doll and struck it with a mallet. Punching and throwing the doll were also imitated almost exactly.

Although direct rewards are not essential for imitative responses to occur, when given to either the child or the observed model they increase imitative behavior. When the model is punished, he is not imitated. Interestingly, however, in one study when all the children were offered attractive rewards for doing what they had seen the model do, those who had seen a model punished and had failed to imitate him originally now showed as many of the previously observed responses as the group who had watched a rewarded model (Bandura, 1962). [▲]

In an investigation of the possible role of imitation of aggression in the home, simulated family groups of three persons—a man, a woman, and a child—were used.

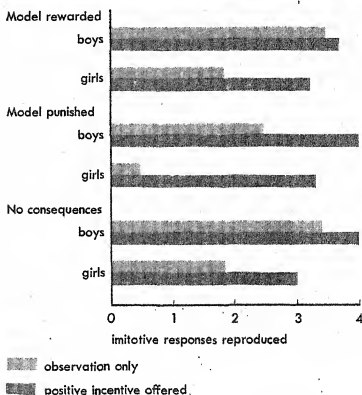
In the first part of the experiment one adult played the role of controller of resources and positive reinforcements. In one experimental condition these rewards were given to the other adult, while the child was largely ignored; in another condition, the child was the recipient, with the other adult assuming a subordinate, relatively powerless role. For half the boys and girls in each condition the male model played the dominant role, as in a home dominated by the husband. For the other half, the woman took the controlling role. In the second part of the experiment the models showed contrasting patterns of behavior in the presence of the child, and a record was kept of which model was most often imitated by the child.

Imitation was largely of the model who had earlier controlled the rewards, whether the rewards had been received by the subordinate adult or by the child himself. Cross-sex imitation also occurred. That is, boys imitated the dominant female and girls the dominant male. However, this tendency was stronger in girls than in boys. It is noteworthy that the children did not imitate the dominant model entirely but also reproduced some characteristics of the lesser parent figure. This indicates, as is often obvious in real-life situations, that imitation by children results in behavior which is an amalgam of elements from both parents and often from other models as well (Bandura, Ross, and Ross, 1963b).

Aggressive responses that have had intermittent reinforcement in a nonfrustrating situation where no other children are present have been observed to generalize to a competitive situation later with another child.

▲ EXPECTED CONSEQUENCES DETERMINE PERFORMANCE

Children who watched an aggressive model who was punished imitated the model less often than those who watched a model who either suffered no consequences or was rewarded. That the same amount of learning of the aggressive responses had occurred, however, was shown by the fact that when all the children were offered an attractive incentive for acting as the models had acted there was no difference among them in the number of imitative responses reproduced.



Based on Bandura, 1962

Two groups of seven-year-old boys received reinforcement with marbles for hitting a large clown doll. One group received continuous reinforcement; the other was reinforced on a fixed 1:6 schedule. One control group had two play sessions with the doll but received no reinforcement, while another control group had no experience with the doll.

For the testing session each boy was matched against another boy chosen at random from the rest of the seven-year-olds in the school. The session consisted of competitive physical-contact games and a period of free play. The boys who had been reinforced intermittently showed significantly more physical aggression in the testing situation than did children in the continuously reinforced group or in either of the control groups. There

were no significant differences among these three groups (Walters and Brown, 1963).

As with other types of learned responses, resistance to extinction is greatest for aggressive responses following intermittent reinforcement (Cowan and Walters, 1963). This is one reason why consistency in parental discipline is so important: if wheedling or temper outbursts are occasionally rewarded by being allowed to succeed, for example, such behavior becomes more frequent and is very difficult to get rid of.

Such studies as these show that imitation is an important factor in the learning of aggressive behavior even in the absence of reinforcement but that reinforcement makes such learning more selective and also helps determine whether the learned response will be performed. Reinforcement can also, of course, be an important factor in the learning of aggressive behavior where imitation is not involved.

Punishment is more complex than reward in its effects and hence less well understood. In general, punishment by an authority figure tends to inhibit direct aggression in the presence of that figure, but is associated with high aggression toward others (Bandura and Walters, 1963). Instead of reducing aggression, punishment may simply make the individual more selective in choosing his targets.

This role of punishment, as well as the effects of both models and direct rewards in teaching aggressive behavior, is seen in a study comparing the parents of a group of inhibited boys with those of a group of aggressive boys.

In this study it was found that the parents of the inhibited group were, in general, neither permissive nor punitive toward aggression. Therefore the children had had little opportunity to learn aggression through either imitation or direct reinforcement and rarely showed aggressive responses. On the other hand, the parents of the aggressive boys tended to be aggressive themselves; thus they provided aggressive models for imitative behavior. Moreover, they permitted and even encouraged aggression directed toward other children, although they punished aggressive behavior directed toward themselves (Bandura, 1960).

The learning of dependency. A good definition of *dependency* is: "a class of responses

that are capable of eliciting positive attending and ministering responses from others" (Bandura and Walters, 1963, p. 139). Because of the helplessness of the infant, dependency responses are reinforced to a large extent during early life in nearly all cultures. In our own society, *task-oriented* dependent responses become reinforced less and less as the child grows. That is, he is taught to feed and clothe himself and encouraged to master certain other skills and developmental tasks that will make him independent of others.

On the other hand, certain types of *person-oriented* dependency are expected and reinforced throughout development and in adulthood. Of course, the primary objects of person-oriented dependency change. Proximity and physical contact are sought primarily with the mother at first, later with peers, and gradually with members of the opposite sex. The dependency of the mature adult usually is expressed primarily toward the marriage partner, but certain forms of dependency, such as the seeking of help and approval, are shown toward a wide variety of friends and acquaintances. Failure to develop and maintain appropriate person-oriented dependency defined in this way is, indeed, an indication of serious behavior disorder. Failure to develop adequate task-oriented independence, however, is not often regarded as a sign of psychopathology, but rather is seen as a sign of low initiative, poor motivation, inadequate social resources—or just laziness.

Relatively few observational or experimental studies have been made of how dependency and independence are learned. However, the parents of highly dependent, nonaggressive adolescent boys have been found to be more demonstrative and warm in showing affection than those of nondependent, aggressive boys (Bandura and Walters, 1959).

Younger children generally show greater dependency when their mothers have rewarded dependency.

Children aged six to twelve were blindfolded and asked to walk along a narrow plank raised eight inches from the floor and balanced on springs. The experimenter touched the back of each child's hand as he started to "walk the plank," implying willingness to help if need be. Children who grasped the proffered hand

tended to have child-centered parents who had encouraged dependent behavior and held the children back somewhat in the development of skills appropriate for their age (Heathers, 1953).

Because person-oriented dependency is often a prosocial form of behavior, parents are reluctant to admit that they have punished or failed to reward dependency. Hence it is more difficult to obtain data about the relation between parent behavior and the development of dependency than it is to obtain comparable information in regard to aggression. In an experimental situation, however, it has been shown that children rewarded for dependent responses during a training session subsequently made more dependency responses toward the rewarding agent. Those who had been mildly rebuked showed a decrease in dependency responses. Reward had a greater effect on girls than boys (Nelsen, 1960).

Children of highly nurturant parents tend to learn nurturant behavior through imitation at the same time that they are learning dependent responses, just as the children of aggressive parents tend to learn aggressive behavior through imitation. This is reflected in the finding that nursery-school children who frequently sought help and affection usually tended, in turn, to give affectionate, helpful responses to their playmates (Hartup and Keller, 1960).

The effects of punishment on dependency are complicated by the fact that rewards must inevitably be given for such behavior from time to time, since children are dependent on adults for the satisfaction of many of their needs. When punishment is interspersed with reward, the effect is often the same as intermittently withholding reward—namely, dependency is increased, especially in individuals whose previous experience has made them highly dependent (Baer, 1962). On the other hand, as in the case of the children in the Nelsen study described above, adults who are consistently punished for dependency responses in psychotherapeutic sessions show a decrease in such responses (Winder, Ahmad, Bandura, and Rau, 1962). Not surprisingly, inhibited and aggressive children react somewhat differently to punishment of dependency responses. In the study of inhibited and aggressive boys already men-

tioned, withdrawal was the characteristic reaction of the inhibited boys, whereas *increased* dependency was observed in the aggressive boys as a result of such punishment. The investigator suggests that this may have been partly because the mothers of the aggressive boys tended to disregard mild forms of dependency and reinforce only the more vigorous forms, as a means of terminating the unpleasant situation; also the extreme dependency response of the aggressive child often is as much an aggressive response as a dependent one (Bandura, 1960).

Models and the development of values. Human goals can be classified according to the importance they have in one's life—that is, according to their *value* to the individual. If a goal seems well worth attaining, we say that it has a high degree of value. When it seems scarcely worth attaining, we say that its value is proportionately small.

Everyone is motivated by a system of values, shaped largely through his experience in his home environment. For example, a child who grows up in a home where money-making is valued above all else is likely to accept the material values of his parents, who function as models. On the other hand, a child whose parents admire self-sacrifice and public service is more likely to learn to be motivated by *those* values. Teachers, pastors, and other individuals with whom the child comes in contact may also serve as models. Some children become alienated from their parents for one reason or another and adopt the values of models outside the home. An adolescent who rebels against his parents will probably want to "belong" in a group outside the home and will base his behavior on the interests and values of that group. The fact that models play an important role in the child's establishment of standards for his own behavior is indicated by the following study.

Children watched adults performing in a simulated bowling game where a dish of candy was available for the taking. Those who saw adults rewarding themselves freely with candy after poor or mediocre behavior thereafter took candy themselves more often after poor shots than those who saw adults rewarding themselves only after excellent performance. Children who had

experienced failure in a previous task rewarded themselves more often after poor and moderate achievement than did children who had experienced success in the earlier task (Bandura and Whalen, 1966).

Social learning is very important in determining our interests as well as our values. For the most part we become interested in the things we can do well and which receive some degree of approval from those around us. An individual seldom becomes seriously interested in an activity at which he repeatedly fails or of which those he admires disapprove.

The vocational interests young people develop typically show both the influence of adult models and the power of a socioeconomic environment to foster certain interests and discourage others by its patterns of approval and disapproval. This was shown in a study in which the Strong Vocational Interest Blank was used to measure the interests of college freshmen.

The students were divided into nine groups on the basis of father's occupational level and parents' education. Although there was considerable overlap in the interests of the students, stable differences on the basis of socioeconomic background were found. That is, students tended to be interested in vocations in the same general area as those of their fathers. For example, sons of farmers showed highest interest in being a veterinarian, a farmer, or a vocational agriculture teacher. The general trend was for students from homes with fewer cultural advantages to show interest in vocations stressing quantitative or technical rather than verbal training—physicist, carpenter, etc. Those whose fathers were professional men were more interested in a profession—psychologist, lawyer, or physician. Their greater cultural advantage was reflected in higher interest in entering artistic fields (Hewer, 1966).

Motivation and Work

Most employed adults spend a third to a half of their waking hours at work. For this reason, many industrial psychologists have made extensive inquiries into the area of motivation for work to determine what factors in the job situation satisfy or dissatisfy the worker and how these relate to quantity and quality of the work performed.

The needs of the worker. The complexity of the worker's needs and desires is being appreciated more and more by modern management. Formerly most managers believed that the average man disliked work and had to be coerced into working by the threat that his basic physiological needs could not be met otherwise. Constant control and direction were considered to be necessities, with power concentrated in the hands of the individuals at the top of the organization's hierarchy. Fortunately this theory, called "Theory X" by one psychologist, is losing ground in favor of "Theory Y" (McGregor, 1960). According to Theory Y, the worker's needs are organized in a series of levels. In today's "affluent society" he takes the fulfillment of basic material requirements largely for granted. With these needs satisfied, and therefore no longer serving as motivators, he seeks satisfaction at higher levels, striving to build up his ego and achieve a richer sense of identity. Many of these higher needs can be satisfied through his work, provided it gives him an opportunity to make some decisions on his own. An organization subscribing to Theory Y, therefore, permits the individual worker to participate in setting goals and gives him a chance to learn what others are doing and to improve his relations with them and with the organization as a whole. Power is no longer so highly concentrated in the hands of a few. Experimental evidence of the advantages of this approach will be reported in Chapter 15.

A number of studies have found that the intrinsic satisfactions derived from work—the factors which fulfill the higher needs of the worker—are more important than physical working conditions or even monetary compensation in determining job satisfaction. For example, in a study of eighty-two engineers and fifty accountants, intrinsic variables were mentioned more often than extrinsic in describing past job situations, both satisfying and dissatisfying (Wernimont, 1966). However, nearly twice as many extrinsic items were reported for dissatisfying situations as for satisfying ones. Apparently workers are more likely to voice their feeling about extrinsic factors when they are dissatisfied. Good salary and working conditions are not unimportant to the worker but are expected as part of his work contract and

cause concern only if they do not meet his expectations. For persons engaged in less creative work, extrinsic factors would be expected to play a larger part in job satisfaction. With blue collar workers too, however, intrinsic factors have been found to be positively related to attitude toward the job, (Malinovsky and Barry, 1965).

In general, both employers and union leaders have tended to overemphasize the importance of economic factors in determining worker satisfaction.

This lack of understanding was brought out clearly in a study in which workers from several companies were asked to choose from a list of 71 items the 5 that were most important to them personally. Fifty top executives of the same companies and 42 union officers were asked to rank the items in the order they thought the workers would rank them. Results for the 10 items most frequently mentioned by the workers are shown in the table at the right.

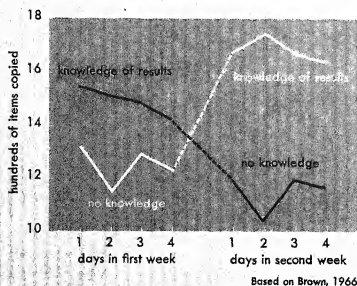
Although the most frequently mentioned item, job security, was recognized as important by executives and union officials nearly as often as by the workers themselves, most other items showed a wide discrepancy in rankings. The workers' desire to be kept informed of their successes and failures (fifth in workers' rankings) was not even included in the first 40 items mentioned by either executives or union leaders (National Industrial Conference Board, 1947).

Factors	Employees	Executives	Union Officers
job security—employment stabilization	1	2	2
opportunities in the company for advancement	2	4	18
compensation—base pay	3	1	1
employee financial benefits (pensions, etc.)	4	8	19
practice of informing you of your job status (successes and failures)	5	40+	40+
type of work	6	7	39
vacation and holiday practices	7	3	8
profit-sharing plans	8	13	40+
physical working conditions (on the job)	9	5	4
company's attitude toward employees (liberal or conservative interpretation of policies)	10	6	6

*A rank of 40+ means not in the top forty ranks.

A fifteen-year study conducted by asking applicants for work at a large gas company to rank ten job factors on the basis of importance consistently found security in first place for the male applicants, followed by advancement and type of work. Pay was ranked sixth; benefits, eighth. In the same study women applicants ranked type of work at the top and benefits at the bottom, with pay in seventh place (Jurgensen, 1961). By contrast, employees in an engineering factory in Calcutta and a group of skilled and semiskilled workers in England both ranked pay in first place (Ganuli, 1954; Graham and Sluckin, 1954). It seems likely that such rankings reflect the particular context in which they are made. For example, workers whose pay is adequate or who work in a generally prosperous cultural setting might be expected to rate pay as less important than workers where rates of pay are not adequate. Rankings based on self-reports are also somewhat suspect: workers may not know what they really want most or

EFFECTS OF CHANGING TO KNOWLEDGE OF RESULTS



may regard security and advancement as more socially desirable goals with which to identify themselves (Opsahl and Dunnette, 1966).

Although amount of pay is not the most important factor in determining worker satisfaction, the way in which pay rates are established is related to job satisfaction (Opsahl and Dunnette, 1966). The basis of pay, as the worker sees it, has also been shown to be related to performance on the job.

In one study, 563 middle and lower level managers rated three performance factors on the basis of how important they thought them in determining their pay. They also rated themselves on the quality of their performance and the amount of effort they expended in performing their duties. Independent ratings were also obtained from superiors on these two factors and on the qualifications and ability of the managers. Results showed that the more important the managers felt job performance was in determining their pay, the higher they were rated by superiors, as well as by themselves, on both quality of job performance and effort expended (Lawler, 1965).

Such studies as those reviewed here indicate that if workers are to be happy with their jobs, both extrinsic and intrinsic aspects of their work must be satisfactory.

Knowledge of results as a motivator. In addition to fostering general job satisfaction, management is on the alert for specific procedures which may still further increase production among satisfied workers. One of these, which is especially effective in certain monotonous, repetitive tasks, is *knowledge of results*.

In a document-copying task, sixteen young men worked for two weeks, one week with knowledge of results (a counter which automatically showed how many sheets had been copied), and one week without. For half of them knowledge was given during the first week and for the other half during the second week. A control group of four men worked the whole time under either knowledge or no-knowledge conditions. Significantly more work was accomplished when knowledge of results was given than when it was not (Gibbs and Brown, 1956).

A further breakdown of the data from the above study showed the effect of knowledge of

results to be significant only when the condition of knowledge of results *followed* the condition of no-knowledge (Brown, 1966). ♦ This, of course, is the order of events which would occur in real life if clerical employees who had not been given complete knowledge of the quantity and quality of their output were to begin receiving that information.

Level of intended achievement as a motivator. Other studies indicate that providing a definite goal to be achieved leads to greater accomplishment than general encouragement to do well.

In laboratory study of this form of incentive, seventy-one subjects performed the simple task of listing things or objects which could be described by a particular adjective, such as "heavy" or "hot." Each object was to be in a different category; that is, only one hot beverage would count. Other items had to be in a different classification—"weather" or "stove," etc. Fifteen trials were administered, a different adjective being used on each. Different "standards of success" were given each group. The Easy group were told they should produce at least five answers. The Medium group were to produce ten and the Hard group fifteen. These were regarded as *levels of intended achievement*. Results indicated that the Hard group performed best and the Medium group next best. The Easy group produced least responses, despite the fact that they had shown a significantly greater output than the other two groups on a practice trial which had indicated levels of ability.

In the second part of the study, the task was to list uses for common objects, such as an ash tray. In addition to an Easy and a Hard group, there were a Self-set group, who were simply told to give as many uses as they could, and a Progressive group, who were given gradually more difficult standards. The Self-set group set only moderate standards to achieve. Again the Hard group outdistanced the Easy group, continuing to improve on each trial even though they were seldom able to achieve the difficult standard set for them. Increasing the difficulty of the standard for the Progressive group resulted in increased output. (Locke, 1966).

In a later study similar results were obtained on a complex motor task which consisted of moving a set of controls in such a way as to produce a pattern of green lights which would match a pattern of red lights showing on a panel. Again, subjects given standards to achieve

did better than those who were simply told to do their best (Locke and Bryan, 1966).

CHAPTER SUMMARY

In any action beyond a simple reflex, the organism is guided by complexes of internal conditions, called *motives* or *drives*, which serve to direct the organism toward specific goals. A motivated act is complete when the goal is reached, and the action which achieves this goal is called a *consummatory response*. The first modern approach to the problem of motivation was made by Lashley, who regarded motivation as controlled by the responses of the central nervous system to stimuli.

Motives influence behavior by causing a relevant stimulus pattern to win over competing ones or by causing the individual to seek external objects or situations not present at the time, and by making energy available through the action of a *general arousal system*. Measurements of the arousal component of motivation have shown the relation between arousal and excellence of performance to be in the form of an *inverted U*. Both *biological drives* and *psychological motives* play a part in human motivation.

The inborn biological drives arise out of inherited structures, although the ways in which they are satisfied are greatly influenced by learning and operate as regulatory mechanisms which help the organism make necessary changes in internal environment.

Of all the drives, *hunger* has received the most study. Contractions of the stomach play a part in causing the awareness of hunger in most cases, but hunger sensations apparently do not depend on them. Studies have shown that the complex processes involved in regulating hunger and the other biological drives are "cleared" through the *hypothalamus*, which contains both excitatory and inhibitory centers for the various drives. Other nearby brain centers also play a role in controlling drives. Studies of prolonged semistarvation have shown that

the most pronounced psychological effect is apathy, with loss of sexual interest but no decline in intelligence. Animals and human beings experience specific hungers which are often of value in maintaining health but which, in the case of human beings, are often overruled by learned habits of a less beneficial nature.

Under conditions of deprivation the *thirst* drive is more intense than the hunger drive and also shows certain qualitative differences. For example, the behavior of thirsty animals tends to be stereotyped, while that of hungry ones is more varied. Thirst is affected by total amount of water in the body, concentration of chemical substances in the cells, and condition of the stomach, as well as by the condition of mouth and throat tissues.

Severe *air deprivation* for exceedingly brief periods may result in permanent neural damage. Other biological drives are associated with *fatigue* and *sleep*. The need for sleep is the same everywhere but the patterns by which we satisfy this need are to some extent culturally determined. *Warmth* and *cold* as drives lead to long-term measures for environmental control and to *servo control*, or use of external sources to regulate body temperature.

Next to hunger, the *sexual drive* probably has the greatest implications for social living, largely because sexual expression is so closely governed by both law and custom. Although hormones play a role in the sex drive, causing men's sex appetites to be noncyclic and women's to be cyclic in nature and bringing men to a peak of desire at an earlier age than women, the most common cause of sexual maladjustment is inadequate or inaccurate sex education. In fact, sex is to a certain extent a learned appetite.

Pain may be regarded as a drive when it is relatively prolonged and can be escaped by appropriate action. It is closely related to its general emotional setting. *Bowel and bladder tensions* play an important role in motivation in early childhood but are of little significance as drives in adulthood.

Monkeys show an inborn need for *contact comfort*, invariably favoring a "cuddly" substitute mother to a wire one even when the latter is the source of nourishment. Normal satisfaction of this contact need is also essential for later sexual adjustment and maternal behavior.

All the biological drives are regulatory mechanisms that enable the organism to achieve *homeostasis*, that is, to maintain the constancy of its normal internal environment. Although many homeostatic activities are largely automatic in nature, homeostasis also involves an active effort of the organism to establish a constant environment, including a stable *social* environment.

Man's complex psychological motives are of great importance in social living. Although these needs are met in very different ways in various cultures, their satisfaction in some form is essential to the individual's health as well as his happiness. Some psychologists have speculated that these drives may be inborn, although the forms in which they are expressed are learned. *Curiosity*, for example, appears to be inborn, and serves as a powerful drive indeed.

One of the important psychological motives seen in man but not in the lower animals is the *need to achieve*, a drive which is greatly influenced by early training. This and other psychological motives are probably acquired as the result of a learning process in which *symbolic rewards* become increasingly important in influencing behavior. Like primary rewards, symbolic rewards are more effective after a period of deprivation. However, expecting too much of a young child may lead to *negativism*.

Recent research has shown the importance of *models* in the development of both *aggression* and *dependency*. Novel responses may be made as a result of observing the behavior of others even when the observer does not make any overt response at the time and even if neither the observer nor the person he is watching receives any reward. Although aggressive behavior is a typical reaction to frustration, it may be

produced in the absence of frustration through imitation of an aggressive model or through selective reinforcement for aggressive responses, or both, and occurs regardless of personality structure. Immediate rewards are not essential for imitative responses to occur, but rewards to either the observed model or the imitator increase imitative behavior. Like other learned responses, aggressive responses are more resistant to extinction following intermittent reinforcement and will generalize to other situations.

Dependency responses, capable of eliciting positive attending and ministering responses from others, may be learned in a similar way. *Task-oriented* dependency is reinforced less and less as the child grows, but certain kinds of *person-oriented* dependency are encouraged. Parents of dependent, nonaggressive adolescents tend to be more warmly affectionate than those of nondependent, aggressive boys. *Values* and *interests*, which serve as important social motives, are acquired largely from parents and, later in life, other individuals who serve as models.

The needs of the individual play an important motivational role in his work situation. Since satisfaction of the worker's basic material needs can be largely taken for granted in today's society, he looks to his job as a source of satisfaction of higher level needs. *Intrinsic* factors are more important than *extrinsic* ones in determining job satisfaction. Extrinsic factors are more likely to be singled out when workers are dissatisfied than when they are satisfied. Workers tend to produce more when given *knowledge of results*, particularly if this follows a period of no knowledge. Production is greater when *high standards for achievement* are set than when standards are low or unspecific.

Chapter 12

Outline

ASPECTS OF EMOTION

EMOTION AS CONSCIOUS EXPERIENCE
EMOTION AS ENERGIZER

THE EXPRESSION OF EMOTION

EXPRESSION AND INTERPRETATION
PATTERNS OF OVERT BEHAVIOR IN EMOTION

PHYSIOLOGICAL CHANGES DURING EMOTION

GLANDULAR RESPONSES
THE GALVANIC SKIN RESPONSE
PUPILLOMETRICS
DO THE PHYSIOLOGICAL CHANGES CONSTITUTE THE EMOTION?

THE ROLE OF THE NERVOUS SYSTEM IN EMOTION

THE AUTONOMIC OR VISCERAL NERVOUS SYSTEM
CENTERS OF EMOTION IN THE BRAIN

EMOTIONS AND HEALTH

PSYCHOSOMATIC REACTIONS
THE GENERAL-ADAPTATION-SYNDROME
PLEASANT EMOTIONS AND HEALTH

HOW EMOTIONS DEVELOP

EARLY EXPERIMENTAL FINDINGS
MATURATION AND LEARNING IN EMOTIONAL DEVELOPMENT
EMOTIONAL DEVELOPMENT IN CHILDHOOD
EMOTIONAL BEHAVIOR DURING ADOLESCENCE
ADULTHOOD AND EMOTIONAL MATURITY
EMOTIONAL PROBLEMS OF OLD AGE

ADJUSTMENT IN MARRIAGE

CHOOSING A MARRIAGE PARTNER
FACTORS IN MARITAL HAPPINESS

Chapter 12 Emotion

Defining an emotion precisely is very difficult. There is no clear-cut distinction between emotional and nonemotional behavior, nor are there any sharp lines of demarcation between one emotion and another, for the human emotions blend into one another like the colors of the spectrum. Moreover, the basic emotions—gloom, delight, love, fear, anger—often combine in various degrees to produce complex emotional patterns such as romantic love, religious ecstasy, patriotism, zeal, awe, hatred, and contempt. Even pleasant and unpleasant emotions are often mixed. The man who is promoted to a better job in a different city, for example, may be torn between pride in his achievement and regret over leaving his friends.

A further problem in defining emotion is the generalized nature of an emotional response, which literally involves the entire organism. It is difficult, if not impossible, to observe and measure all the physiological and psychological changes that make up an emotional response. We can, however, distinguish various aspects of behavior we designate as "emotional" and can study each of these in appropriate ways.

ASPECTS OF EMOTION

Although a person's feelings cannot be observed directly by another but must be inferred from his overt behavior and from his verbal report of his introspections, no one can doubt the reality of emotion as conscious experience.

Emotion As Conscious Experience

To produce an emotion, a stimulus situation must be perceived and evaluated as significant.

This means that the present situation must be related to past experience and seen as having implications for the future. The presence of a dangerous situation, for example, does not arouse fear or dread in us unless we *perceive* it as dangerous. If we fail to recognize the threat, no emotion may be aroused, or if we are completely confident of our ability to handle the situation, we may see it as an interesting challenge and feel exhilaration rather than fear or dread. Thus our evaluation and subsequent emotion are strongly influenced by our estimate of our own capabilities.

Such evaluation may also involve cultural factors such as family, church, and political philosophy. It can occur with great suddenness and, according to some psychologists, on a subconscious basis. We automatically feel pride at the sight of our flag, anger at the sight of someone hurting a child, or disgust at the sight of slovenly table manners. We sometimes get into trouble in dealing with people of other cultures when an act we interpret as courtesy, such as arrival on time, is regarded by them as rudeness and poor taste. The emotions aroused depend not so much on the events themselves as on how they are evaluated.

The method of introspection has been employed extensively by psychologists to identify and analyze the basic components of emotional experience—the internal bodily sensations felt and their intensity and localization, as well as the other conscious elements. On the basis of introspective reports, psychologists have arranged emotions along a dimension of pleasantness-unpleasantness. This they call the *affective scale*.

Introspection has its limitations, of course, and information obtained by this method must be recorded carefully and interpreted with caution. First of all, if the introspections of different individuals are to be compared direct-

ly, they should be reported in exactly the same language. This obviously is a difficult requirement, for it is hard to give specific names to subjective phenomena. And even if we use a common vocabulary, we never can be certain that the sensations we feel are exactly the same as the sensations felt by another person. When two people both report that they have a "quivering sensation in the pit of the stomach," there is no way for us to be sure that they are having the same inner experience.

Emotion As Energizer

Emotions play a vital part in our motivational patterns. A life without *emotion* would be virtually a life without *motion*. The similarity between these two words is no accident. Both are derived from the Latin word meaning "to move." Often we speak of a person as "moved to anger" or "deeply moved" by sorrow. Like the biological drives discussed in the preceding chapter, emotions may arouse, sustain, and direct activity in the organism, and thus play an energizing role in an individual's life. Like other motives, too, the emotions may serve to direct behavior either *toward* some desired object or condition or *away* from some object or situation. Yet they differ from the biological drives in two important ways.

First, as we have seen, an emotion starts with a cognitive reaction to an external stimulus, whereas a biological drive is a pattern of stimulation and/or chemical conditions associated with certain tissue needs of the organism. Second, the arousal and satisfaction of biological drives may come to follow rather automatic sequences, whereas emotions, especially negative ones, usually arise in emergency situations where habitual, organized responses are not appropriate or adequate. For example, the thirst you feel when the water supply of your body tissues becomes low is a relatively simple drive which you can easily alleviate by drinking a glass of water; the behavioral responses involved in such a situation have come to be habitual and automatic. But if you wake up in the night to find your room in flames, you have no such automatic pattern of response available. You

are in an emergency situation and must devise an appropriate response in a hurry.

When emergencies arise that must be met with immediate and direct action, emotion helps the individual cope with the situation in at least three ways:

1. In a state of strong emotion a person is capable of action over a longer period of time than would be possible if he were entirely calm. An outstanding feat of endurance made possible by emotion is described in the story of a western pioneer, John Coulter.

In 1806 Coulter and a companion named Potts stopped along the Missouri River to hunt and trap. Suddenly a war party of about eight hundred Blackfoot Indians appeared and ordered them to come ashore. Coulter did so and was disarmed and stripped. Potts, who resisted, was killed. Coulter himself expected to die a slow and horrible death, but the Indians decided to give him one slight chance for his life. He was to run for his life, with his scalp as the prize of victory. Pursued by a party of young warriors armed with spears, Coulter, who was thirty-five, dashed away at a speed that astonished himself. After two or three miles he developed a nosebleed and rapidly began to grow weaker, but he had outstripped all his pursuers but one, who rushed at him with a spear. Coulter managed to break off the iron spearhead and stab the Indian.

Feeling strong once more, he seized the brave's blanket and raced on to the Madison River, five miles from his starting point. Here he hid in a beaver house until night. After the Indians had left, he swam the river and then climbed an almost perpendicular mountain partly covered with snow, since he feared his enemies would be guarding the only mountain pass. He then traveled day and night toward the fort three hundred miles away, eating roots and bark and stopping only for a minimum of rest. Eleven days later he arrived and described his experiences to his general (James, 1916).

2. Strong emotion also enables an individual to exert maximum strength momentarily. In one case, when a tornado struck, a weak old woman, bedfast with a chronic heart condition, lifted her six-year-old granddaughter, who was standing by the bed, and placed her on the other side of the bed next to the wall. Later she was incapable of such exertion and, in fact, died a few days afterward. Combat veterans report similar incidents in which they experienced

sudden bursts of strength or of unusual endurance during crises, especially when survival was at stake.

3. Strong emotion renders an individual less sensitive to pain. Quite often a soldier wounded in combat is completely unaware of his wound until the battle, with its high pitch of emotion, is over. Similarly, an athlete in an important game may go on playing, not realizing that he has a broken bone.

These emergency responses, made possible by involuntary activities of the body in strong emotion, undoubtedly helped primitive man to survive in a hostile environment. The cave man, confronted by an attacking animal, could run faster and longer if he had plenty of sugar in his blood stream and plenty of air in his lungs. Or, if he had to drive a small beast away from his cave or engage in hand-to-hand combat, he could strike harder blows.

Although strong emotions are still of adaptive value to us in situations where endurance is a major factor, they can work to our disadvantage on other occasions. Complex performances

are impaired by very strong emotion. Thus while a runner may do better in an actual meet than he did in the preliminaries, a golfer generally does better in practice than under the pressure of serious competition. Stage fright is an illustration of the damaging effect of strong emotion on an individual's ability to execute well-learned verbal responses.

The complexities of modern life also tend to reduce the adaptive value of physiological mobilization during emotion, for many of our emergencies cannot be met by direct physical action. We cannot take a hatchet to the car that refuses to start—or to the teacher who gives us a failing grade. Nor can we run away from our most common fears.

Civilization now forces us to respond to emotion-provoking stimuli with words or indirect activities. Unless we can find some satisfactory way to express our emergency emotions, they may handicap rather than help us in making an effective adjustment. In fact, the visceral activity involved in emotion can result in physical illness if it continues over a long period of time.

The physical expression of emotion plays an important part in our interaction with the world around us. The overt responses of body parts, face, and vocal mechanism are directly involved in manipulating the environment. In anger, for example, we may hit an enemy—or, if he is too dangerous, withdraw. With smiles, frowns, and gestures we influence other members of our social group.

Expression and Interpretation

Empathy—the ability to understand and, to some extent, share the experience of another person's feelings—depends greatly upon the ability to interpret an individual's expressive be-

havior. This in turn seems to depend upon a genuine interest in and concern for that person. Some people evidently have a greater capacity for empathy than others, but everyone learns to judge with some accuracy the emotional reactions of the people among whom he works and lives. Long association with a particular person, of course, acquaints one with his peculiarities of emotional expression.

In normal social interaction we have several clues by which we judge the effects that our words have on the other person. The more such clues we can put together, the more successfully we can interpret his emotional behavior.

Facial expression. A person's face is usually a barometer of his emotion, perhaps giving warn-

ing that our words are too strong, perhaps reassuring us that he is receptive to our ideas. There are, however, significant limitations on the ability to interpret emotion from facial expression. While the competent professional actor can register emotions that will be interpreted with a high degree of consistency, the facial expressions of the ordinary person are less stylized and cannot be judged so accurately, although they are easier to judge in adults than in children. ■ Some persons seem to have more definite and more easily identifiable patterns of facial expression than others. Moreover, there appear to be considerable differences in the ability of individuals to interpret facial expression of emotions in others.

In an attempt to provide an objective scheme for relating the different facial expressions of emotion, one investigator obtained 72 pictures of the same face, posed to express different emotions, and had observers sort the pictures into one of six categories: (1) love, happiness, mirth; (2) surprise; (3) fear, suffering; (4) anger, determination; (5) disgust; (6) contempt. He found a high correlation in the judgments of the



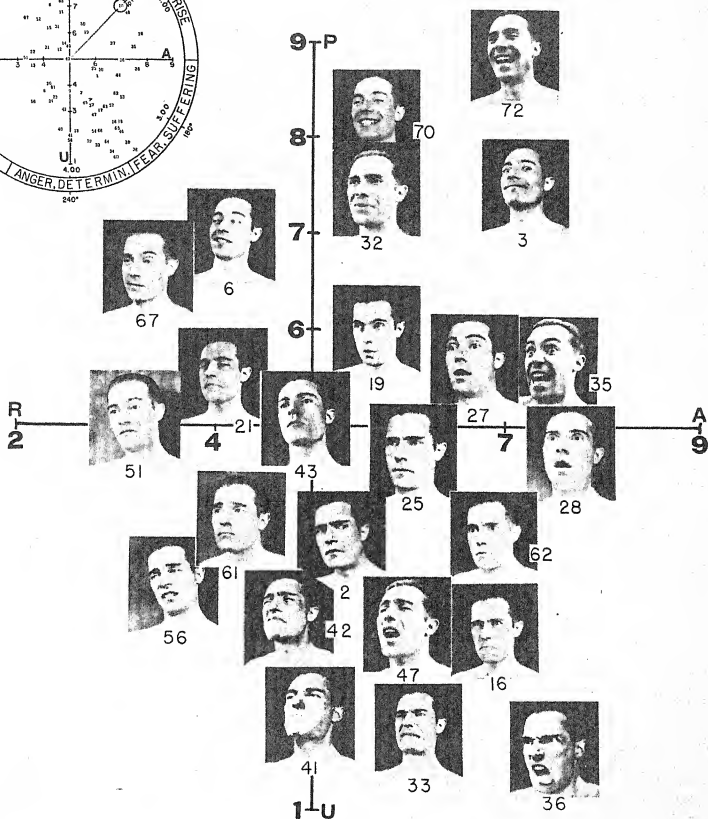
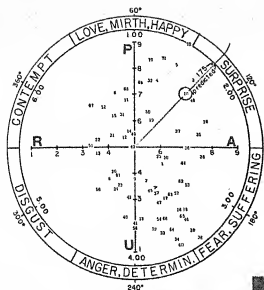
■ How do you "read" this little girl's facial expression? After you have made up your mind, turn to page 421.

different observers but noticed that in several cases pictures posed to express love were confused with those posed to express contempt. When the experimenter put his categories into a circle instead of along a linear scale, the slight "spillover" of judgments between the contempt and love categories was no more than that between other neighboring categories. But when the pictures were all given positions around the periphery, the important dimension of intensity was not taken into account. The experimenter found that by conceiving of the circle as a surface and making judgments of each picture on two axes—pleasantness-unpleasantness and rejection-attention—he could place each picture with reference to both quality and intensity, as shown on page 419 (Schlesberg, 1952).

Vocal expression. The adult human voice is even richer than the face in varieties of emotional expression. Changes in inflection, loudness, pitch, or timbre may be used to express various types of emotional experience. A rising inflection, for instance, generally conveys a feeling of surprised doubt or incredulity: "What! Is it time to go already?" The rising, then falling inflection shows sarcasm: "What a smart idea *that* was!" A slow, dragging monotone expresses defeat and dejection: "I failed the examination." Loud, hoarse, staccato speech with much variation in pitch—characteristic of the sports broadcaster—suggests excitement.

Patterns of emotional expression, present in childhood, become increasingly clear-cut as the vocal apparatus matures. While these patterns appear to have an innate basis, they are complicated by learning and social imitation. That is, the precise "tone of voice" associated with a particular emotional reaction is determined in part by social convention, although the higher pitch and strident tones associated with anger, for example, are undoubtedly inborn. The increase in body tension causes more tension in the vocal cords, thus "raising" the voice. Quavering and stuttering are evidently native expressions of fear, and are frequently imitated by the actor who wants to convey a feeling of fear to the audience.

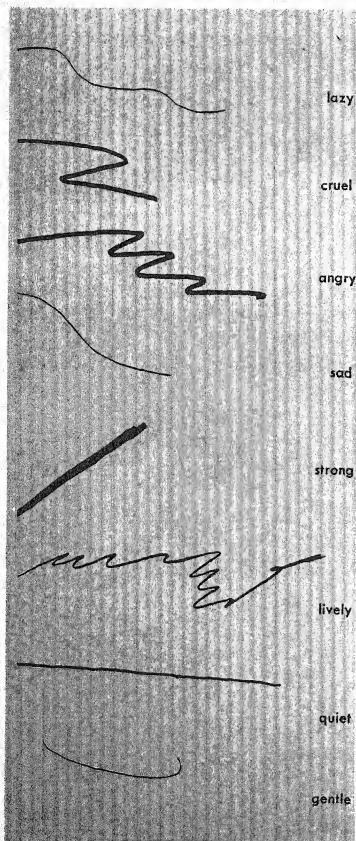
These forms of vocal expression are familiar to everyone, and there is no doubt that the sound of a person's voice is a helpful indicator of his emotional state. In most situations, however, voice is only one of many indicators; usu-



These pictures are some of the ones used by Schlosberg, shown placed on the two axes: pleasantness-unpleasantness and rejection-attention. The periphery and the two axes, as shown in the diagram, permit the location of any picture with respect to two dimensions of facial expression: quality and intensity. Intense emotions are placed near the periphery; more neutral ones toward the center.

▲ SELECTED GRAPHIC RESPONSES TO WORDS REPRESENTING EMOTIONAL FEELINGS

The lines reproduced here seemed to the subjects who drew them to express graphically the meaning of these adjectives. Subjects showed considerable similarity in their interpretations of the same words.



ally we are aware of the stimulus situation and can also observe the individual's facial expression and overt behavior. But if an observer is unable to see the individual and is ignorant of the stimulus situation, the voice is an ambiguous indicator of emotion. Taken alone, even adult vocal patterns of emotional expression are not always recognizable.

Graphic representation. The effects of emotional feelings on such forms of graphic expression as drawing or handwriting have not been systematically studied. However, recent evidence indicates that normal individuals agree quite closely on the kind of lines they associate with various emotions.

A group of 188 United States Air Force trainees were asked to draw a single line expressing the meaning of each of twenty-four adjectives. Responses were classified according to form (straight, curvilinear, wavy, or angular), direction (horizontal, upward, or downward), and intensity (light, medium, or heavy stroke). In general, the direction of the line showed a relationship to the social desirability of the feeling or behavior described by the word. Thus downward lines were usually used to express such words as "cruel," "lazy," "sad," or "dead," while upward lines were used for more desirable attributes such as "earnest," "strong," or "joyous." Words suggesting overt activity, such as "lively" or "furious," usually elicited lines which were angular or irregular in form. Curved lines were used for "gentle" and straight ones for "quiet." The strength of the emotion described was reflected in the intensity of the stroke, light lines being used for adjectives like "gentle" and heavy ones for "angry" or "cruel" (Peters and Merrifield, 1958).

These results do not justify conclusions as to how the various emotions described would actually affect the graphic representations of persons *experiencing* the emotions. That is, we cannot say that sad people would produce more downward strokes than happy people in handwriting or drawing, or that angry people would use heavy strokes. Further research is needed, comparing the graphic work of persons in various emotional states, before conclusions of this kind can be drawn.

Emotion and social perception. Emotions and the degree to which they are expressed or re-

pressed affect social perception. This was brought out in an experiment in which sixty college students, while subjected to fear arousal stimuli in the form of electric shock, viewed a film of a young man taking various performance tests.

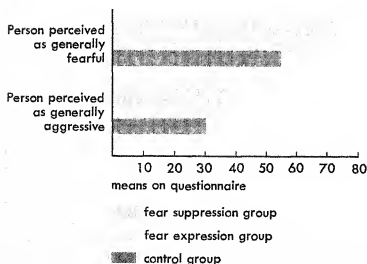
There were two experimental groups, both of whom were told that the purpose of the experiment was to determine the effects of distraction upon the accuracy of one's judgment of other people. To make this more plausible, they were required to remove pins from a finger dexterity board during the film, in addition to receiving periodic painful shocks. A control group received no shocks.

The Fear-Expression group were told that many people are disturbed by shock and the best thing to do in order to perform well on the main task was to express any feelings of fear freely. In contrast, the Fear-Suppression group were told to try not to think about their emotional reactions but to concentrate on the task as hard as possible. Following the film, subjects filled out a questionnaire on the personality characteristics of the person filmed. This covered judgments of direct and indirect fear in questions like: "How worried do you think he was while working on the various tasks?" and "How much tension do you think he usually works under?" Other questions, such as, "How frequently do you think he loses his temper?" were designed to measure indirect aggression judgment. Still others measured judgment of negative personality. A sample

Would you make the same judgment now as to what her facial expression signifies? A large part of our perception of emotion in others is actually inference based on our understanding of the situation as a whole.



PERCEPTION OF FEARFULNESS AND AGGRESSIVENESS

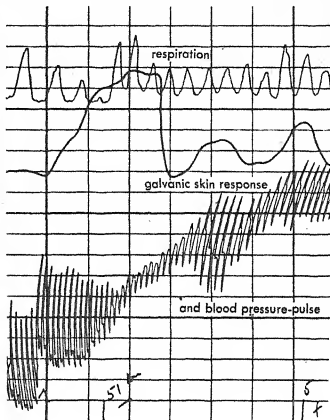
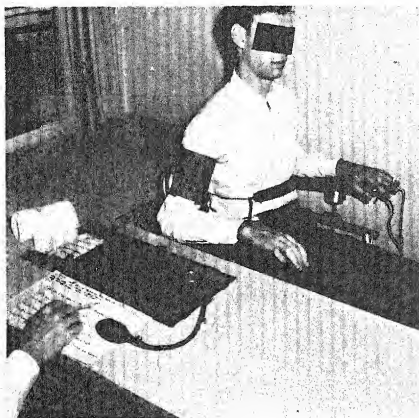


Based on Feshback and Singer, 1957

was: "How much reliance do you think one can place upon his word?"

Both the Fear-Suppression and the Fear-Expression groups perceived the stimulus person as significantly more aggressive and significantly more fearful than did the controls. Although differences between the Fear-Suppression and the Fear-Expression groups were not statistically significant, they were in the predicted direction, namely, perception of greater fear and aggressiveness on the part of the group who had suppressed their own feelings. In fact, a significantly greater proportion of the Fear-Suppression group than of the Fear-Expression group used extreme categories in describing the amount of fear present in the stimulus

◆ The "lie detector" is a collection of instruments designed to measure the intensity of certain involuntary responses during questioning. In the apparatus shown here, records can be made on the moving paper of the suspect's galvanic response, respiration, blood pressure-pulse, and general muscle activity. Often deception will show clearly on only one measure; respiration is often the most sensitive. This record is unusual in indicating deception clearly on three measures. The number 51 at the bottom marks the completion of Question 51 by the examiner; the negative sign means that the suspect answered, "No." Signs of deception are: (1) the two rapid inhalations and subsequent shallower breathing; (2) the sustained galvanic response, which began before the question was finished; (3) the pulse rate change, indicated by differences in the frequency of up and down strokes; (4) the rise in blood pressure; and (5) the change in position of the notch in the down strokes in the blood pressure-pulse record from the center to the bottom of the stroke.



person. Thus the data indicate that the arousal of fear results in a tendency to project fear onto other stimulus objects, this tendency being somewhat greater when the original fear is suppressed. It is interesting to note also that the tendency to perceive the stimulus man as fearful was significantly correlated with the tendency to perceive him as aggressive (Feshbach and Singer, 1957).

Patterns of Overt Behavior in Emotion

Although a description of human emotions on the basis of corresponding patterns of overt behavior is not at all perfect, and although any classification of emotions is somewhat arbitrary, it is helpful to consider emotional behavior pat-

terns in four broad categories: *destruction, approach, retreat, and stopping of response.*

Destruction. In anger the typical behavior is attack. An angry animal or an uncivilized man makes a physically destructive attack—he throws himself upon his enemy, biting, scratching, choking, hitting, spitting, or snarling, according to his species. But with civilized man, the attack is more often symbolic. Words take the place of blows; physical injury gives way to sneering words that are intended to lower the prestige of the enemy in the eyes of his fellows. The end result of anger is, nevertheless, essentially the same in man and beast—real or symbolic destruction.

Approach. In pleasant emotions the essential response is approach. The biological function of approach to the stimulus object is to permit further stimulation. Elation is essentially an approach reaction which follows success in any activity—or which anticipates success; as when the confident athlete becomes elated before an important event.

Retreat or flight. Fear typically involves retreat or flight. Flight from a dangerous situation may be physical or symbolic and is often the best mode of adjustment. Suppose that in crossing a street you hear a horn and look up to see an automobile bearing down upon you. You run. Actual flight of this sort is typical in many situations involving physical danger that cannot be escaped by less direct means. Indeed, some people try to escape from frustrations and irritations by moving aimlessly from place to place, job to job, or even spouse to spouse. In civilized life, however, we more often retreat symbolically through words—apologies, compromises, discussion—or through various psychological mechanisms of withdrawal. Typical withdrawal

reactions (daydreaming, forgetting, and the like) will be discussed in the next chapter.

Stopping of response. Gloom is an emotional reaction that does not involve destruction, approach, or retreat but rather a widespread stopping of usual responses. In grief, an extreme form of gloom, the individual fails to respond to even the most potent stimuli. There are patients in mental hospitals, for example, who will not eat unless they are forcibly fed.

A milder form of gloom is apathy, seen in the extreme "zombie-like" behavior of many American prisoners of war in Communist Chinese prison camps during the Korean War. These men characteristically displayed no interest in their environment during imprisonment and even showed little or no emotion upon being released from prison and sent home. Perhaps this was an adaptive response. Although helpless to fight or escape from the tremendous physical and psychological hardships daily inflicted upon them, they could avoid responding and thus minimize their actual suffering.

PHYSIOLOGICAL CHANGES DURING EMOTION

As we have already noted, the conscious content of emotional experience in others can be studied only by an examination of their verbal reports, and we can never be sure that such reports are precise descriptions of what actually is being felt. The physical responses involved in emotion can be observed much more directly and objectively, and described in quantitative terms.

Of all the indicators of emotion, the most easily measured are the internal physiological activities that occur throughout the organism. Indeed, many psychologists maintain that these physiological responses *are* the emotion. Whereas awareness of an emotion may be suppressed and most external responses can be

voluntarily inhibited by the individual, visceral responses are not usually subject to voluntary control. Measurement of physiological changes is thus the most sensitive and objective method of studying emotion and is the source of most experimental data. ♦

Glandular Responses

When a person experiences a strong emotion such as anger, the medulla of the adrenal gland pours into the blood stream an excessive amount of the hormone *adrenaline* and a second hormone, *noradrenaline*. The first is responsible for many characteristics of strong

emotional experience. Under its influence the liver releases stored sugar into the blood, and chemical changes occur which cause the blood to clot more quickly. Blood pressure rises; the pulse becomes more rapid and more vigorous; the air passages into the lungs enlarge to admit more air. The pupils of the eyes enlarge so that more light may enter. Sweat breaks out all over the body, particularly on the palms of the hands. The temperature of the skin may rise several degrees.

Noradrenaline brings about constriction of the blood vessels at the surface of the body, thus making more blood available elsewhere. This action also helps to prevent loss of blood if the person is wounded. There is evidence that the thyroids and the pituitary also are involved in emotional response.

The glandular responses in emotion help the organism to cope physically with emergency situations. But if the emotion-provoking situation cannot be met by direct action and continues over a period of time, the accelerated activity of certain endocrines may actually prove harmful to the organism. This relationship between emotions and health will be discussed a little later in the chapter.

The Galvanic Skin Response

Closely associated with the visceral and neural activity occurring during emotion are certain significant changes in the electrical properties of the body. When perspiration breaks out on the surface of the body during emotion, two important changes occur in the electrical properties of the skin: (1) the tissues actually generate an electromotive force (voltage) and (2) the electrical resistance of the skin is changed. These changes, which may be measured with great sensitivity by special electrical apparatus, constitute the *galvanic skin response* (GSR). In older texts this response was often called the *psychogalvanic response* (PGR).

Since the sweat glands respond to a part of the nervous system that is not under conscious control, the galvanic skin response—in combination with blood pressure and respiration—is a highly sensitive objective indicator that an emotional response is taking place. This fact has

been used in the development of the lie detector. Consciousness of guilt engenders a fear reaction; therefore, if an individual is guilty, he will respond emotionally to questions related to his crime. By asking both "critical" and "neutral" questions and comparing the degree of emotion that different questions produce—through measuring the individual's respiration rate, his blood pressure, and his galvanic response—a skilled lie-detector operator is usually able to determine with fair certainty whether or not the subject is telling the truth.

It has been shown that the lie detector can detect guilty knowledge even when no lies are told and the subjects are deliberately trying to "beat the test."

The twenty subjects included medical students, staff psychologists and psychiatrists, and secretaries. The principle of the lie detector and the nature of the GSR were carefully explained to them; they were allowed to practice producing GSR's and were offered \$10 if they could avoid detection. They were informed that the best way to defeat the lie detector would be to produce false GSR's to the innocent alternatives in as random a pattern as possible.

A record was then made of the GSR's of each subject while he listened to statements like, "Your father's first name is: (a) Richard, (b) John, (c) Robert, (d) William," etc. In each case one alternative was true. Although the subjects tried to produce misleading GSR's, not one was able to earn the \$10 by concealing his "guilty" knowledge (Lykken, 1960).

The lie detector is not infallible, however, even in the hands of a skilled technician.

In a complex study conducted at Indiana University in cooperation with the Office of Naval Research, liars were detected 60 to 70 per cent of the time in most of the experiments. The series of tests included experiments in which a single factor alone—such as galvanic response, blood pressure, or breathing rate—was measured in an effort to detect lying. In other experiments the factors were combined in various ways. Some of these combinations yielded correct results in 80 to 90 per cent of the cases. The investigators felt that these percentages were the highest that could be expected under the conditions of the research.

The galvanic skin response gave the best results of any single physiological factor, yielding success in 79

per cent of the cases. In this particular experiment, the subjects were asked to circle on a printed list the name of one of the first six months of the year and then to answer "No" to all questions concerning which one was circled: "Is it January? Is it March?" etc. Thus they would lie one time in six. An interesting result was that when the students were informed that their lies had been detected and then were retested, using the last six months of the year, only one third as many lies were successfully detected. A second group were told that their lies had not been detected on the first run, and a control group were given no information about results of the first trial. In both of these groups about the same percentage of lies was detected the second time as the first (Ellson, Davis, Saltzman, and Burke, 1952).

Experiments such as this throw valuable light on how well lying may be detected by measurements of physiological processes. In these studies, however, the examiner knew how often the subject was going to lie. A law enforcement officer using a lie detector has no way of knowing whether the suspect is likely to lie about almost everything or whether he will tell no lies at all. Furthermore, some individuals are not well suited to testing. These include the very intelligent person, who may gain considerable voluntary control over his visceral responses; the mental retardate, who may not appreciate the significance of the situation; and the highly nervous individual, who may react emotionally to nearly all questions asked (Burger, 1952). Testing is also difficult with the so-called "psychopathic personality," who does not possess normal feelings of remorse or guilt for criminal actions, and the "false confessor," who seems to delight in confessing to crimes he did not commit. In spite of these and other limitations, however, the lie detector is an extremely useful investigative aid.

The galvanic skin response has been used in another connection—in measuring the strength of emotion in prejudice.

After having rated a number of groups as "liked intensely," "neutral," or "disliked intensely," college students listened to statements that either praised or disparaged these groups. As they listened, their GSR's were recorded. There was evidence of more emotion when disliked groups were complimented than when liked groups were criticized. Statements about groups

toward whom the students felt neutral evoked relatively little response.

In another part of the experiment students listened to complimentary statements about nine ethnic and national groups and the experimenter ranked the groups on the basis of the students' galvanic skin responses. Later the students themselves ranked the groups by circling the name of the preferred group of a pair, such as Jews-Mexicans, each group being paired once with every other. This ranking corresponded closely with that obtained by the experimenter: the degree of emotion aroused was in direct proportion to the stated dislike for the group being complimented (Cooper, 1959).

Pupillometrics

A new method of measuring physiological changes which occur during emotion, *pupillometrics*, is based on the fact that the pupil of the eye dilates in response to stimuli which arouse a favorable reaction in the subject and contracts in response to distasteful stimuli. The recent discovery of this fact is really a rediscovery, since Charles Darwin spoke of the eyes widening or narrowing during emotion, and as early as the Middle Ages oriental rug and jade dealers veiled their eyes or wore crude smoked-glass spectacles to avoid letting their enthusiasm over a rare piece of merchandise be revealed by pupil dilation, leading to an increase in asking price.

In 1960, the rediscoverer, Eckhard Hess, was relaxing by looking at some photographs of animals after getting into bed. As he came to a particularly beautiful picture, his pupils dilated. His wife happened to notice it and suggested that he must be using a poor light. He assured her that he was not, but began to wonder why his eyes had reacted as they did. Recalling Darwin's reference to the pupil as an indicator of emotion, Hess conducted an impromptu experiment the next day. He showed one of his male assistants a number of photographs, including a magazine photo of a nude pinup girl. Hess shuffled these and held them in such a way that he himself could not see which one he was showing. As the seventh picture was shown, the assistant's pupils suddenly enlarged to about a third more than their normal size. Sure enough, the seventh photo was the pinup girl. Systemat-

ic work then began, and the equipment shown in the illustration was developed to measure pupil reaction. » The subject looks into one end of the black box, in which the light is controlled so that it will not affect pupil size. As he looks at pictures, a movie camera focused indirectly through a mirror takes pictures of his eyes at the rate of two per second. After the pictures are enlarged to twenty times life size, the dilations and contractions of the pupil can be carefully measured to within 1/20th of a millimeter.

The apparatus has been employed in a variety of tests. Cats' pupils, for example, have been shown to dilate when movies of mice are shown. People's eyes react to pleasant and unpleasant tastes and sounds, as well as sights. True feelings contradictory to those expressed by the individual also show up, as in the case of a girl whose pupils contracted whenever she was shown modern art reproductions, although she professed to be a lover of modern art.

It is expected that pupillometrics will be of great value in psychotherapy, particularly as a diagnostic tool. The patient who can tell his psychiatrist nothing about the root of his trouble, often because he himself is unaware of it, may reveal important sources of difficulty as he looks at pictures showing stress situations, mother-father relationships, and the like.

Homosexuality can be discovered through pupillometrics, and it is hoped that such tendencies can be revealed in time to take corrective action to prevent personal tragedy. In a study performed with ten normal young men and five admitted homosexuals of the same age, background, and education, the pupil response of the normals was much greater when looking at pictures of nude women than of nude men. The homosexuals responded in the opposite way (Hess, Seltzer, and Shlien, 1965).

There is also a strong possibility that pupillometrics can be used in lie detection. It offers the hope of more accurate results when teamed with the conventional lie detector, because the pupil contracts only in response to unpleasant stimuli, whereas the GSR changes for strong emotion of any kind. Anxiety over being regarded as a suspect may thus confuse the results and make the innocent appear guilty. In pupillometrics, the pupil size at the beginning of the test, obtained while the subject looks at neutral stimuli, is taken as a basis for comparison. This provides a safeguard, so that larger pupil size caused by anxiety over the test itself will not be confused with changes in pupil size caused by viewing pictures of the scene of the crime or other emotion-charged stimuli.

Do the Physiological Changes Constitute the Emotion?

Just what part the physiological responses play in our conscious experience of pleasant or unpleasant emotions such as anger or fear or elation is a question which has long puzzled psychologists. A few have followed the early psychologist William James, who expressed the rather extreme view that bodily changes directly follow our perception of an exciting fact and that our awareness of these bodily changes is the emotion. As James put it, three quarters of a century ago, "Common-sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike." But, he maintained, this simple sequence is not correct. The bodily changes occur in between, so that "the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble. . . ." (James, 1890, p. 448)

Photo by Art Siegal, reprinted with permission from The Saturday Evening Post © 1966, The Curtis Publishing Co.



■ Dr. Hess is shown here demonstrating his device for measuring the change of pupil size. The image of the eye, greatly magnified, is shown on the television monitor.

An elaboration of this view, called the *James-Lange theory of emotion*, exerted a strong influence on psychologists and led to a great deal of research on the patterns of physiological change involved in the different emotions in an attempt to find identifiable differences. Surprisingly, few differences in visceral responses were found—not enough to account for the wide range of felt emotions. In fact, just doing mental arithmetic, with no experience of emotion, can cause as much acceleration of the heart action as immersing the foot in a bucket of ice water—an emotion-arousing emergency situation (Knapp, 1963). Thus some investigators have concluded that cognitive factors must play a major role in determining whether physiological arousal is part of an emotional state and if so, which one.

A recent experiment endeavored to test objectively the role played by cognitive as opposed to physiological factors when subjects had been given a shot of adrenaline and thus were undergoing the physiological changes common in strong emotion.

The subjects were male college students who had agreed to receive an injection of "Suproxin" (purportedly a vitamin compound) and thought the study was to test its effects on vision. Some of the subjects received adrenaline and the others a placebo consisting of normal saline solution. Of those receiving adrenaline, a third were informed that there would be harmless side effects such as pounding of the heart or flushed face, which would last fifteen or twenty minutes. Another third were merely told that the injection was mild and harmless. The final third were misinformed, being told that they would have itching sensations or a slight headache.

After the injection, each subject was told that there would be a twenty-minute delay before the vision testing. During this twenty minutes he was placed in either a "euphoria situation" or an "anger situation." In the first situation, the subject was left in a room with a stooge, supposedly a waiting subject like himself, who announced that he "felt just like a kid again" and proceeded to sail paper airplanes, play with a hula hoop, and so on. The experimenter watched what happened through a one-way screen and recorded the extent to which the subject joined in the gay activity. In the anger situation both the subject and a stooge were asked to fill out a questionnaire. The questions, innocuous at first, became more and more insulting, and the

stooge became more and more "incensed," finally tearing up his questionnaire and stamping from the room. The experimenter observed and recorded the degree of anger exhibited by the subject. In both cases, a further measure of the subjects' feelings was obtained by having them fill out questionnaires afterwards concerning their feelings.

Pulse readings before and after the twenty-minute session showed that the placebo subjects became physiologically aroused just by the dramatic activities of the stooges. In spite of their visceral sensations, the adrenaline subjects who had been correctly informed of the side effects showed and reported less emotion (either euphoria or anger) than the placebo subjects. The two groups who had received adrenaline but no explanation for their bodily sensations or an inaccurate prediction were the ones most readily manipulated into the desired emotional state, whether euphoria or anger. They showed and reported more emotion than the placebo group and twice as much as the accurately informed adrenaline group (Schachter and Singer, 1962).

This experiment indicates the importance of cognitive factors in emotion. In a follow-up study, however, in which there was no contradiction between the perceived situation and the felt internal changes, it was demonstrated that the degree of physical arousal is also important in determining the intensity of felt emotion.

In this study, subjects received either adrenaline, a placebo, or chlorpromazine, a drug which tends to inhibit the action of the sympathetic nervous system and thus has an opposite effect from that of adrenaline. The subjects who had received adrenaline reacted most strongly, with the most boisterous expressions of amusement, to a humorous film. The placebo subjects tended to show milder amusement, while the chlorpromazine subjects showed the least reaction (Schachter and Wheeler, 1962).

Emotional activity induced by cognitive factors was clearly demonstrated in a study involving lie detection.

Half the subjects were subtly motivated to be detected in lies by being told that it is exceedingly difficult for normal individuals to keep from making the involuntary responses associated with lying, whereas mentally disturbed persons, who can lie with no feeling of guilt, can much more easily avoid detection. The other half

were motivated to deceive the machine by being told that only individuals with superior intelligence and control are able to do so.

After the first trial, half the subjects in each group were made to feel they had been successful in deceiving the machine and half were led to believe they had been unsuccessful. Those who thought they had deceived the machine but perceived their role as one in which they should be detected were more easily detected in subsequent trials. The same was true of subjects motivated to deceive the lie detector and informed that they had been unsuccessful in doing so. In both cases the subjects were

receiving information indicating that they were not performing as they felt they should be and thereafter their involuntary responses were stronger and more easily detected (Gustafson and Orne, 1965).

In summary, it seems apparent that physiological arousal is an essential factor in emotion, but that it is guided or steered by cognitive factors. Present cognitions, including evaluations based on past experience, provide a framework within which the individual can understand and label his feelings (Schachter, 1963).

THE ROLE OF THE NERVOUS SYSTEM IN EMOTION

All of the internal and many of the external signs of emotion are commanded by the *autonomic* nervous system and carried out by smooth muscle tissues of the viscera, by the heart muscle, and by the glands. Of course some of the objective signs of emotion, such as smiling, cowering, or fleeing, are carried out by the somatic nervous and muscular systems. The modern point of view is that the two systems are different peripherally but similar and intermingled in the central control areas of the brain. At any rate, an understanding of your emotional life is not possible without some rudimentary knowledge of how the nervous system functions in emotion.

The Autonomic or Visceral Nervous System

The autonomic or visceral nervous system sends fibers to the visceral organs of the chest, abdomen, and pelvis and to other structures containing smooth muscles or glandular tissue. • (The efferent part of the somatic system sends impulses only to the skeletal muscles.) The term *autonomic* is a misleading one, since this part of the nervous system is neither autonomous (self-regulating) nor automatic. It is made up of a set of reflex arcs which are sub-

ject to the control of certain centers in the brain just as are the reflexes of the somatic nervous system, but with the important difference that in the case of the visceral nervous system these centers are largely in the hindbrain rather than in the cerebral cortex. Thus very little voluntary control of visceral functions is possible without special training. Control of the skeletal muscles can, of course, be either reflex or voluntary.

The autonomic nervous system also differs from the somatic components of the nervous system in having synapses outside the central nervous system. All the synapses of the somatic components are located in the brain and spinal cord.

Physiologists and anatomists distinguish two parts of the autonomic nervous system—the *sympathetic* and *parasympathetic* divisions.

The sympathetic division. Branching off from certain of the spinal nerve roots are small bundles of fibers which run to a chain of ganglia lying on either side of the spinal cord. The fibers run up or down in this chain and then form a synapse with effector neurons that run to smooth muscles and glands of the skin, via nerve branches which rejoin the spinal nerves. At certain points, nerves leave this chain and

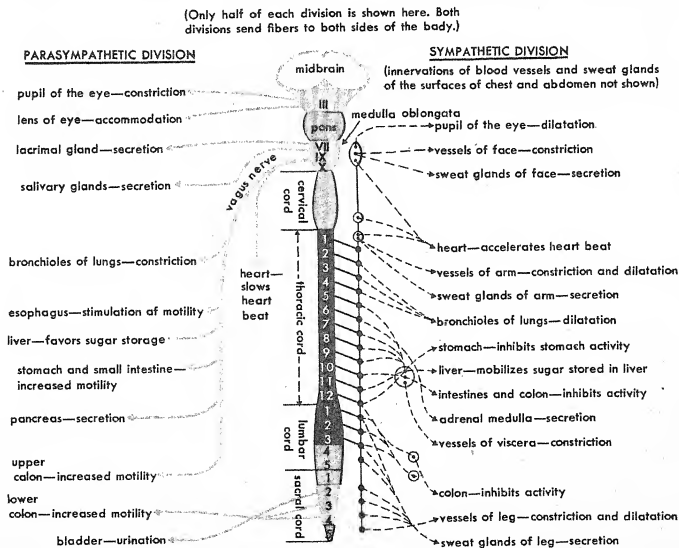
pass to more distant ganglia where their fibers synapse with others that run to the visceral organs. Since the fibers of this system originate only in spinal cord segments in the middle of the back (*thoraco-lumbar*) but ultimately reach structures from the head to the toes, it is clear that the sympathetic chain is a distributing mechanism containing many fibers running up and down, giving off numerous collaterals. This part of the autonomic system is called the *sympathetic* division, because early anatomists believed that its function was to make the visceral organs work "in sympathy."

The parasympathetic division. From the lower segments of the spinal cord and from the brain stem originate certain nerves which look

like ordinary spinal and cranial nerves but, when traced, are found to pass to visceral structures rather than to the skeletal muscles. And, like the sympathetic nerves, they are interrupted by a synapse outside the central nervous system, often in the wall of the organ innervated. Since they branch off from the central nervous system above and below the sympathetic nerve fibers, they are known as the *parasympathetic* or *cranio-sacral* division of the autonomic system.

Most organs of the chest and abdomen receive fibers from both divisions, and where this happens the action of the two divisions is always antagonistic: if one excites the organ to increased activity, the other inhibits or decreases its activity. Thus the autonomic nervous system

THE AUTONOMIC NERVOUS SYSTEM



makes for a very effective control of the visceral organs. It could be likened to the accelerator and the brake of an automobile. One system is not the accelerator of *all* organs and the other the brake of *all* organs, however. Which of these systems inhibits or activates a particular organ depends on what that organ does.

Division of labor in the autonomic system.

Most of the vital functions of life are governed by the parasympathetic division. The sympathetic plays a minor role in such activity; in fact, the whole sympathetic division has been removed from animals without greatly disturbing the ordinary processes of life. The parasympathetic division protects the eye from bright light by constricting the pupil and adjusts the lens of the eye for near vision. It also controls the passage of food along the alimentary canal, its digestion, and finally the elimination of wastes. During sexual excitement, the sexual organs become suffused with a richer supply of blood by the action of this division. During orgasm, the sympathetic division is in control, proving that the two divisions are not always antagonistic but can work together in sequence.

If the parasympathetic is the drudge that carries on the everyday tasks of life and meets the minor exigencies, the sympathetic division is the trouble-shooter which takes charge in the case of a serious emergency. It operates when the life of the organism is threatened, and it calls upon all the reserves of energy which parasympathetic activity has built up and held in abeyance for just such emergencies. The sympathetic is known to take over under three conditions: (1) during cold so extreme as to threaten life, (2) during any violent effort or exercise, and (3) during fear and rage.

The action of the sympathetic division in anger includes dilating the pupil of the eye, lifting the lid overwide and protruding the eyeball, speeding up the heartbeat, and raising the blood pressure. In extreme anger, the sympathetic division enables the liver to pour out sugar to be used by the muscles, the spleen to pour out more blood cells to carry oxygen, and the bronchioles to dilate so that more air reaches the lungs. There is a cessation of the digestive movements, of peristaltic contractions of the stomach, and of secretion of digestive

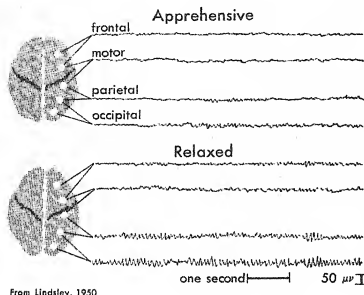
juices. The blood that would normally go to these organs is diverted to the muscles. In hairy animals the hair stands on end; in humans this is seen as a vestigial response in the form of "goose flesh." Finally, the adrenal glands are spurred to great activity and the adrenaline secreted into the blood stream duplicates the actions of the sympathetic division and hence reinforces all the above processes.

Visceral sensation. In the same nerves with the motor fibers going to the visceral organs are numerous sensory axons returning from them. Those found in the sympathetic nerves are concerned with conducting pain impulses; those found in parasympathetic nerves usually conduct impulses giving rise to organic sensations from the stomach, colon, and bladder. The latter are necessary for the reflex control of the viscera in such functions as vomiting and urination. This double pathway of sensation from the viscera makes it possible for surgeons, by severing appropriate sympathetic nerves, to relieve excruciating pain from diseased visceral organs without affecting the messages that travel over parasympathetic fibers involved in homeostatic adjustment.

Ordinarily we are quite unaware of any movement going on in our viscera. The pupils of our eyes dilate in pain, but we do not become aware that they have done so. When we believe we are aware of our viscera, as in thinking we feel the heartbeat, we are really receiving the sensation from the chest wall and not over the sympathetic nerves from the heart. If the abdominal cavity is opened under local anesthesia the viscera can be cut, pinched, or even burned without arousing pain. Yet severe, unbearable pain can arise in the viscera in the form of cramps, stomach aches, and so on, and we are all familiar with strong sensations of hunger and nausea. Because of the protected position of the viscera, there has been no occasion for sensitivity to cutting and burning to develop, whereas distensions and contractions have become adequate stimuli.

You may be wondering why, if contraction is adequate stimulus, we are unaware of the normal peristalsis of the intestines. This is a matter of *threshold*. When the contractions are normal, as in the ordinary processes of digestion

■ In obtaining EEG's the subject sits or lies comfortably while electrodes placed on the scalp relay to a moving paper the electrical activity going on in the four areas of each side of the brain. The eight currents are thus recorded in parallel form. Shown here are EEG records (for one side of the brain) taken when the subject was apprehensive and then when the subject was relaxed.



From Lindsay, 1950



and excretion, they do not reach sufficient intensity to stimulate the sensory fibers; hence we are unaware of them. If they are strong, spasm-like contractions, however, as in diseased states, we may become very conscious of them. Visceral sensations are danger signals compelling us to take some action to correct what is wrong.

Visceral sensations differ from those arising from the skin in that they are diffuse and poorly localized despite their intensity. In fact, they are often wrongly localized and seem to come not from the viscera but from the skin. Thus severe pain originating in a diseased heart may seem to come from the chest wall or sometimes even from the back of the arm.

Centers of Emotion in the Brain

The autonomic nervous system is only the peripheral part of the neural mechanism for emotion. Higher centers in the brain receive messages from it and deliver messages both to it and to the somatic nerves to give the patterns of emotional display. Both cortical and subcortical structures are involved.

Cortical functioning in emotion. As we have seen, the cerebral cortex produces measurable electrical activity. Changes in pattern of these *brain potentials* during emotion indicate that the cortex plays a role in emotional behavior. The apparatus used in obtaining EEG's is shown above, along with examples from an EEG recording.

The importance of cognitive factors in defining and directing emotional responses has already been discussed. These cognitive factors depend in part on cortical functioning. There seem to be at least three distinct ways in which cortical functioning affects emotional responses.

1. The cerebral cortex is involved in relating current events to past experience—a process which helps to interpret the situation and determine whether or not it arouses emotion. For example, an individual who has driven a car in cold regions will probably have a fear reaction when approaching a patch of ice on the pavement because he recognizes danger. A driver who had never been out of Florida, however, might feel no apprehension. This process is also involved in such refined emotional activity as

the evaluation and appreciation of a symphony or a painting.

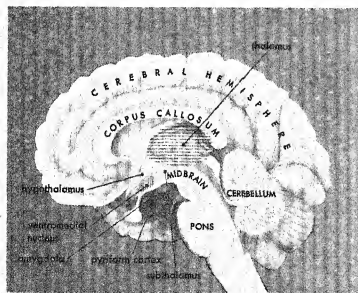
2. The cerebral cortex has some power to execute visceral activity, which is commonly associated with emotional responses. The acceleration of heart rate as a result of doing mental arithmetic, already cited, may be an example of this. Even more direct evidence comes from the stimulation of a strip of cortex running bilaterally from the underside of the frontal lobes back to the tips of the temporal lobes (a part of the primitive *transitional cortex*). Such stimulation produces visceral responses and vocalizations which some investigators have interpreted as being fragments of emotional responses (Fulton, 1939). In contrast to the *subcortical* emotional centers discussed below, these cerebral areas may be responsible for the integration of some of the more complex forms of emotional behavior.

3. The cerebral cortex also serves as a check on unrestrained response. Normally, the intensity of emotional response tends to be propor-

tional to the seriousness of the situation. But when certain parts of the cortex have been destroyed or affected by alcohol, the individual makes wrong or excessive emotional responses. A dog or cat without its cerebral cortex shows no gradations in intensity of emotion, exhibiting only the most primitive emotional responses of pain, rage, and fear, plus certain basic sexual responses (Bard, 1934).

The forward parts of the frontal lobes, called the *prefrontal areas*, are particularly concerned with the inhibition of certain kinds of emotion and the expression of others. Damage to them changes the emotional life of the patient—the kind and strength of his emotions, their appropriateness to the situation, and particularly their intensity. Patients with damage in this area are likely to become lazy, profane, and untidy in their personal habits to the extent of urinating in public or upon the floor at home. Some mental patients have been helped by prefrontal lobotomies, in which the fibers connecting the prefrontal lobes with the subcortical emotional centers are severed. Such patients appear to feel emotion and even physical pain less intensely.

The cerebral cortex is certainly involved in both the maturation and the learning that change the infant's "all-or-nothing" emotions to adult emotional reactions, with all their gradations, flexibility, and subtle nuances. The unrestrained outbursts of the child are not unlike the "sham rage" of the decorticate animal: in both cases cortical control is lacking. But the details of the role of the cerebral cortex in emotional development are still largely unknown.



◆ SUBCORTICAL CENTERS OF EMOTION

The subcortical centers of emotion mentioned in the text can be located only approximately on a diagram such as this. The amygdala, for example, is buried within the temporal lobe. As explained in the text, the septal area in lower animals is a clearly definable region just beneath the forward bend of the corpus callosum, but in man the components have become scattered. The pyriform cortex is a poorly defined area on the underside of the temporal lobe.

Subcortical functioning in emotion. The exaggeration rather than disappearance of certain emotions after removal of the cerebral cortex proves that subcortical structures can organize some emotional responses. These structures have been identified as lying below the cerebral cortex and above the midbrain. ♦ Cutting away the brain down to the midbrain ends all display of emotion.

The important structures between the cortex and the midbrain are the *thalamus*, which receives impulses from the whole body, including the viscera; the *subthalamus*, just beneath it, which exerts control over the voluntary muscles

of emotional expression; and the *hypothalamus*, an important center controlling both the sympathetic and the parasympathetic system. The *rhinencephalon*, the oldest part of the cerebral hemispheres, contains both primitive cortical and complicated subcortical nuclei.

Disease or tumor of these important regions changes the whole emotional life of the patient. A lesion in one spot may bring about a condition of emotional apathy, somnolence, or even narcolepsy. Lesions in others may bring bursts of uncontrollable laughter or tears although the patient *feels* a contrary emotion or no emotion at all. Some patients with such lesions experience emotion but give little or no outward sign; others experience exaggerated pain and emotion although the visceral responses are not increased.

It seems safe to conclude that outward and inward *behavior* and the *experience* of emotion are not one and the same thing (Harlow and Stagner, 1933). This raises two questions: which parts of these subcortical areas carry out *expression* of emotion (muscular, visceral, and glandular responses), and which ones play a part in the *experience*, or inward aspect, of emotion?

Subcortical mechanisms and the expression of emotion. It is pretty certain from experiments in which the whole cerebral cortex and parts of the older structures have been cut away that the subthalamus and the hypothalamus are capable themselves of executing primitive emotions of rage, fear, and sex. Corroborating evidence is found when electrical currents are passed through this region. • Stimulating certain parts of the hypothalamus has been found to throw the animal into rage behavior or into fearlike behavior. These are patterns of behavior involving somatic and visceral components. Rage may be directed to the experimenter, flight to a weak point in the cage.

Besides this fear-rage executing area the hypothalamus contains the *ventromedial nucleus*, which restrains emotion. Tame rats that have been deprived of this nucleus become savage and will bite a metal rod repeatedly; in one case a rat bit the hand of an unsuspecting experimenter who had happened to destroy the area by accident (Wheatley, 1944). It thus appears that nerve cells in or around the ventromedial

• The permanent implanting of electrodes in various areas of the brain makes possible the electrical stimulation of unanesthetized animals. Such stimulation gives important clues regarding the role played by these areas in the arousal and control of behavior.



nucleus normally help inhibit the primitive rage response, which then breaks loose when the area is destroyed.

Further forward, in front of the hypothalamus, is another region of the brain which also helps to suppress primitive emotional reactions. This is the *septal region* of the rhinencephalon, and in lower animals it is located along the dividing line between the two hemispheres, just below the front bend of the corpus callosum. In man, because of the great growth of the corpus callosum, the components of the primitive septal region, while still present, are spread more diffusely in this area but presumably still have similar functions.

Destruction to the septal area causes rats to overreact emotionally to handling or to a star-

ting sound; to urinate or defecate, or to attack an object placed near them—a mixture of fear and rage responses (Brady and Nauta, 1953). Septally damaged animals also learn more quickly than do normal ones to avoid anticipated punishment when a warning signal is presented (King, 1958). Some have suggested that this is because the brain-damaged animals become more easily frightened than normals and have characterized such experimental animals as “hyperemotional.” More recently, however, experiments have made it clear that the septal area and other parts of the rhinencephalon as well are concerned not solely with the control of emotional behavior but also with response suppression in a number of nonemotional types of behavior. Psychologists have thus begun to characterize the septally damaged animals as generally *perseverative* or *compulsive* in their behavior (McCleary, 1966).

Over twenty-five years ago it was discovered that when the temporal lobes of monkeys, including a part of the rhinencephalon within, were removed, the monkeys showed bizarre “oral tendencies,” exploring every object by sniffing it and touching it repeatedly with the lips. The same type of damage resulted in increased sexual activity and had a marked taming effect on the normally wild monkeys (Klüver and Bucy, 1939). It is now known that the exact area involved in the changed sexual behavior is the *pyriform cortex*, a layer on the underside of the temporal lobe. Lesions here cause male monkeys and cats to become so active sexually that another male monkey or cat, a mouse, or even a hen becomes a sexual object. It is not yet clear whether these animals are “hypersexual” in the usual sense of the word or simply are unable to abide by the innate restraints that normally circumscribe the sexual behavior of a particular species.

Removal of the *amygdala*, lying inside the temporal lobe just above the *pyriform cortex*, was apparently responsible for the taming effect of Klüver and Bucy’s large temporal lobe lesions. It is now known that after its destruction alone, wild animals cease to bite and scratch when handled or even pinched (Schreiner and Kling, 1953).

The behavior that follows removal of these areas is the reverse of the behavior they pro-

mote when stimulated in the intact animal. Thus the amygdala acts as an accelerator of emotional responses, with separate zones for defensive behavior and attack behavior having been identified (Ursin and Kaada, 1960). Parts of the cerebral cortex, the septal region, the ventromedial nucleus, and the pyriform cortex, on the other hand, function as brakes. If you remove the accelerator, the animal becomes tame; if you remove the brakes, it runs wild.

Damage to the second member of one of the opposing pairs of structures in the rhinencephalon can offset the effects of damage to the first. A rat made savage by septal damage is promptly tamed by damage to the amygdala (King and Meyer, 1958). Experiments such as this also make it clear that the rhinencephalon has more than one behavioral function. Even when the septal rage reaction is eliminated by a subsequent amygdectomy, the experimental animal still shows the compulsive behavior which is also produced by septal damage (Schwartzbaum and Gay, 1966).

The exact interconnections of all these areas are not yet worked out. It may be that they are linked together as a chain, with messages going from the septal region to the ventromedial nucleus and on to the posterior hypothalamus. Or it may be that messages from these areas act directly on the nerve fibers that produce the visceral and skeletal muscle signs of emotion. Continuing research will undoubtedly tell us more about them.

Subcortical mechanisms and the experience of emotion. Does the animal who attacks or flees during stimulation of the hypothalamus “feel angry” or “feel afraid,” as the case may be? To answer this question, the physiologist must again use methods of experimental psychology since, obviously, the animal cannot introspect and report his experience.

A male rat showing interest in a sexually excited female rat was stimulated electrically in his eating center. The ungallant rat immediately went off in search of food and started eating. When the current was stopped, he returned at once to the patiently waiting female. In this case it was clear that the animal experienced motivation to behave as he did. Blocks of wood the size of food pellets were rejected; thus the eating was not purely mechanical (Ruch, Mairé, and Patton, 1956).

Conditioning experiments provide us with important clues. For example, if a cat is trained to turn off a switch whenever it receives a shock to its feet (escape conditioning), and the shock is then suddenly transferred to the rage-fear center of the hypothalamus, the cat will immediately shut off the current (Nakao, 1958). A cat can also be trained to avoid a dish of food by stimulation of the fear-rage center (Delgado, Roberts, and Miller, 1954). If we can assume that the cat finds the shock to the foot unpleasant, we can make the same assumption about the hypothalamic shock, since it also serves to motivate learning.

Further insight into emotion and motivation comes from experiments in which an electric current has been applied to deep brain structures in rats, and the animals have repeatedly *sought* the stimulus (Olds, 1962; Valenstein, 1966).

Rats with electrodes implanted in the brain were put in a box containing a bar which acted as a switch: whenever the rat pressed the bar, a current flowed through his brain. Without any previous association of bar-pressing with reward, such as food or water, the rats not only learned to press the bar but would press it incessantly, as many as a thousand times an hour.

When the circuit was broken, so that pressing the bar did not stimulate the brain, the bar-pressing stopped. Then, when the circuit was reestablished, the rat again began pressing the bar (Olds and Milner, 1954).

These centers in the brain have been called *reward centers* because the electric current seems

to act as a reward or reinforcement, like food or water, and the animal actively seeks it, even crossing an electrified grid to press the bar. The brain areas that yield the highest bar-pressing rates include the septal region, the lateral hypothalamus, and the central part of the posterior hypothalamus (Olds and Olds, 1963). (Remember that stimulation should produce the opposite effect from a lesion.) The cerebral cortex and most of the thalamic centers leading to it give consistently low self-stimulation scores, indicating again that many aspects of emotion are carried out subcortically.

A recent experiment offers particularly strong evidence that some kind of "feeling" is associated with the activation of these reward centers in the brain.

With an electrode implanted in the lateral hypothalamus near the "eating center" (see Chapter 11), the animals were stimulated repeatedly; each time they were stimulated, an innocuous soft tone was sounded. That some sort of pleasant sensation was associated with the hypothalamic stimulation is suggested by the fact that the animals apparently began to enjoy the sound of the tone itself. In the later absence of brain stimulation, the animals would press a lever repeatedly just to turn on the tone (Stein, 1958).

From such experiments, we conclude that the hypothalamus does more than execute emotional behavior by sending impulses to the muscles and glands. Evidently it also plays a part in the experience of emotion or sends impulses to some other area which does.

EMOTIONS AND HEALTH

Modern medicine has come to recognize the importance of emotional processes as a factor in physical health. Within the past few decades a new medical specialty, *psychosomatic medicine*, has developed, devoted to the diagnosis and treatment of bodily ailments which result at

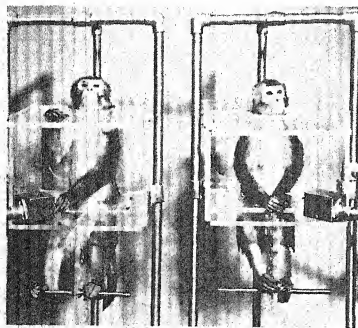
least partially from sustained emotional arousal. The term *psychosomatic* is somewhat misleading, since it seems to imply that mind (*psyche*) and body (*soma*) are separate entities. The word is used here as a convenient term of classification, without reference to the mind-body

problem. Psychosomatic conditions should not be confused with the neuroses and the psychoses, to be discussed in the next chapter.

Psychosomatic Reactions

Many kinds of complaints sufficient to make a person fear serious disease or experience great discomfort—headaches, overpowering fatigue, low back pain—are psychosomatic disorders resulting from sustained emotional tension. Other inwardly expressed psychosomatic disorders also arise from other stressful situations.

Normally the individual soon copes with an emergency, and the various physiological activities accelerated in emotion return to normal levels. Sometimes, however, emotion-provoking situations continue indefinitely and cannot be easily escaped—as with the soldier who is afraid in combat or the man who hates his work. In such situations the individual may maintain an extreme level of physiological activity over a much longer period than is usually true with emergency reactions. If this state of physiological “mobilization” continues for a sufficiently long period of time, tissue damage may occur.



◆ In the “executive monkey” study, conditions for the two monkeys were identical except that one had a lever which would postpone the shock for both of them (left) and the other a dummy lever (right).

The term *psychosomatic disorder* is used to refer both to the symptoms, such as rapid pulse and high blood pressure, involved in a persistent emergency reaction and to actual tissue damage that may result, such as gastric ulcer.

It is estimated that about half of all patients who consult physicians have symptoms caused largely by emotional disturbance. Unless expressed overtly, feelings of hostility, for example, lead to physiological changes in the stomach which over a long period may bring about the development of a peptic ulcer. Emotional factors have also been clearly demonstrated in the development of certain cases of high blood pressure, colitis, migraine, low back pain, dermatitis, obesity, and asthma (Alexander and Szasz, 1952; Halliday, 1953; Seguin, 1950; Wolff, 1953). A more commonplace example of the role of emotion in our body chemistry is the finding that tears secreted during emotion have more albumin in them than tears induced by an onion (Brunish, 1957).

Many studies with animals have shown that prolonged stress can result in tissue damage. Peptic ulcers, for example, have been produced experimentally in animals subjected to stress-provoking situations.

In one study nine rats were kept in a large rectangular box for thirty days. There was food at one end of the box and water at the other, but the floor around the food and water was constantly charged with electricity. If a rat left the central section of the box to eat or drink, he received a shock. Only during every forty-eighth hour was the current turned off. Thus the rats experienced a chronic conflict between desire to obtain food or drink and desire to avoid shock. A control group of five rats were given food and water only at forty-eight-hour intervals but were not put in the conflict situation. Peptic ulcers developed in six of the nine experimental animals, but in none of the controls (Sawrey and Weisz, 1956).

These results were confirmed in a later experiment in which more animals were used and conditions were systematically varied to determine the relative contributions of hunger, thirst, shock, and conflict to the production of ulcers. This study made it clear that emotional conflict contributed significantly to ulcer formation. Hunger added to shock also was another significant factor, but thirst was not (Sawrey, Conger, and Turrell, 1956).

Some of our knowledge of emotional factors in ulcers has come from work with monkeys.

In an experiment at the Walter Reed Army Institute of Research, two monkeys were put in the apparatus shown in the photograph. ♦ Every twenty seconds, if the monkey on the left failed to press the lever attached to the box in front of him, both monkeys received a shock on their feet. If he pressed the lever, the shock for both monkeys was postponed twenty seconds. To stave off the shocks indefinitely, he therefore had to press the switch once every twenty seconds. When he failed to do so, both received a shock. The monkey on the right had a dummy lever, which he soon ignored. Six-hour experimental sessions were alternated with six hours of rest. A red light visible to both monkeys was turned on during the six hours of "avoidance" and turned off during the rest periods.

The first time this experiment was tried, one monkey died on the twenty-third day with what looked like an ulcer. His companion was in excellent health. Which monkey got the ulcer? The "executive" monkey on the left (Brady, Porter, Conrad, and Mason, 1958).

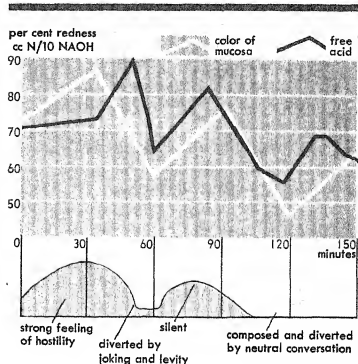
Not all attempts to replicate these findings have been successful. In some cases the animals have not developed ulcers but have shown other serious gastrointestinal disease (Foltz, Millet, Weber, and Alksne, 1964). In other cases even under stress no organic pathology has developed. The phenomenon has been observed often enough for the investigators to be confident that behavioral stress can be an important factor in the development of ulcers, but it is clear that other factors, such as constitutional characteristics and past experience, can also play a role. For example, ulcers do not develop in smaller, younger monkeys than those used in the original studies, even when they are subjected to more extreme stress (Brady, 1966).

An early study established the fact that hostility increases the secretion of stomach acid and produces an engorgement of the stomach lining with blood, evidently through the action of the parasympathetic division of the nervous system.

A patient who had had an injury had an opening into the stomach which allowed the lining to be observed during questioning. When disturbing questions were asked, the stomach lining was observed to flush much

CHANGES IN GASTRIC PHYSIOLOGY ASSOCIATED WITH FEELINGS OF HOSTILITY

This graph was drawn from observations made on the patient whose stomach was open for scientific study. At the beginning, the patient was feeling resentment and hostility as the result of a humiliating experience. While he discussed it, his hostility increased, and there was a greater flow of acid in his stomach and more redness of the mucosa. With changes in his mood, there were corresponding changes in gastric physiology.



Based on Wolf and Wolff, 1947

like one's face in anger and the free acid present rose correspondingly (Wolf and Wolff, 1947).

In the studies investigating the development of ulcers in monkeys, too, it was found that there was an increase in free acid in the experimental animals, though interestingly this occurred during the rest periods which followed the shock-avoidance sessions instead of during the avoidance sessions themselves (Polish, Brady, Mason, Thach, and Niemeck, 1962).

Some studies appear to indicate that psychosomatic reactions, like skeletal responses, are learned. Rats have learned to increase or decrease their heart rate when certain reward centers in the brain are stimulated. Dogs have even been taught to obtain water by salivating—an abnormal reaction during thirst. Ac-

cording to Neal Miller, a psychologist who has done extensive work in the study of motivation and emotion, further research may show that the same process can explain human reactions. For example, one boy may avoid a difficult examination by fainting, while another may accomplish the same end by developing an upset stomach. In early childhood the first boy might have discovered that a great deal of attention from his mother was forthcoming when he fainted. The second boy's mother might have been upset if he showed signs of nausea. If they escaped unpleasantness or at least gained a good deal of maternal attention in these ways, the boys might have learned to control these physiological responses, although not on a conscious level (Miller, 1966).

Often it is difficult to determine whether a patient's complaints are primarily psychological or physiological in origin. Even in cases where psychological factors are obviously the *precipitating* cause, certain physiological factors may *predispose* the patient to display particular symptoms. Often the symptoms of psychosomatic and purely organic disorders are so similar—as in bronchial asthma, for example—that it is extremely difficult to tell whether the patient's primary need is medical treatment or psychotherapy.

Psychological factors may also play an important role in disorders which would seem to be far removed from neural or neuroendocrine control.

Pernicious anemia was found to be associated with depression in ten patients who were studied by means of intensive interviews. In each case there had been a loss prior to the onset of the illness, usually the loss of a loved one. Severe depression had followed, causing a depletion in the gastric secretion and thus contributing to the development of anemia (Lewin, 1959).

In a study of sixteen families followed for a twelve-month period, psychological as well as physical factors were examined. Both streptococcal and nonstreptococcal respiratory illnesses were about four times as frequent following family episodes judged to be stressful (Meyer and Haggerty, 1962).

A recent advance in the study of psychosomatic medicine is the development of a scale

for the quantitative measurement of the total impact of stressful events in people's lives.

Nearly four hundred persons of both sexes, varying in age, race, religion, marital status, education, and socioeconomic status, showed high agreement in their ratings of the degree of adjustment required by various life events. Each of forty-two situations was given a value expressed in terms of "life change units" (LCU). These ranged from 100 LCU's for the death of a spouse to 11 LCU's for a minor traffic violation. Not all the life events listed were unpleasant in nature, for happy events also may require considerable adjustment. Marriage, for example, received a value of 50 LCU's and vacation 13 (Holmes and Rahe, 1966).

When a number of Japanese persons were asked to rate the same life change items, their ratings agreed remarkably closely with those given to the items by Americans, suggesting that LCU's tend to remain constant across cultural boundaries (Holmes, 1966).

On the basis of the data obtained in the above study, a questionnaire called the Schedule of Recent Experience was constructed. This asked for changes in residence, occupation, family, finances, health status, personal status, and social activities, by year of occurrence, over the past ten years. Eighty-eight physicians were asked to fill out the SRE, plus a separate page asking for all major health changes—illnesses, accidents, or surgery—during the last ten years. The purpose of the study was not disclosed to the respondents.

Eighty-nine of the ninety-six major health changes reported, or 93 per cent, were found to have occurred within two years following a cluster of life changes amounting to 150 LCU's or more within a single year. Such a cluster was regarded as constituting a *life crisis*. This association of health changes with life crises was significantly greater than chance association. The relationship was even clearer when life crisis magnitude was considered. For moderate crises of 150-200 LCU only 37 per cent had an associated major health change; while for substantial life crises of more than 300 LCU, 79 per cent were associated with a major health change. These findings suggest that the greater the magnitude of the life crisis, the greater the subject's psychophysiologic activation, resulting in greater probability of bodily dysfunction. A life crisis appears to act as a generalized stressor, making the individual vulnerable to ills to which he is normally resistant. For example, persons who remained well during most flu epidemics were found to have the flu after a major life change (Rahe and Holmes, 1966a).

In a follow-up study, the participating physicians were divided into two groups on the basis of magnitude of life crises experienced during the final year and a half covered by the SRE. One year later eighty-four of the original respondents were successfully contacted to obtain data regarding their health changes during the year. Of the thirty-two changes reported, thirty-one, or 97 per cent, were clearly associated with a life crisis of at least moderate magnitude.

The study confirmed the hypothesis that number of health changes is related to the magnitude of recently experienced life crises (Rahe and Holmes, 1966b).

Such crises may not show their effects until considerably later in life, as was indicated by a study investigating the history of early psychic traumas in cancer patients. A psychic trauma was defined as an experience in which "emotional relationships brought pain and desolation."

Of 450 cancer patients, 72 per cent, as compared to only 10 per cent of a noncancerous control group, were found to have suffered such an experience early in life. It was theorized that the cancer patients had, as children, responded to these crises with feelings of guilt and self-blame. During adolescence and early adulthood, these feelings were submerged as desires and energies were concentrated on school, job, and meaningful relationships with others, particularly the spouse. However, often after as long as forty years, when the pattern was changed, perhaps by retirement from work or by the death of the spouse, and the individual could find no substitute source of satisfaction and meaning in his life, his feelings of guilt and inadequacy returned. Usually the first symptoms of cancer appeared from six months to eight years after this second life crisis (Le-Shan, 1966). Separation or threat of separation from a loved one has often been found to precede leukemia (Greene, 1966).

Physicians are coming to realize that even when symptoms are due primarily to physical causes, emotional strain can work against successful treatment. The emotionally unstable person who suffers from a severe organic disorder may become so depressed by his physical condition that he will lose his normal recuperative powers. At the other end of the spectrum are the many cases on record of patients determined to get well who have done so despite a

physician's opinion that they were beyond recovery.

Emotional factors are particularly important in such organic disorders as tuberculosis, heart disease, diabetes, and epilepsy. In treating tuberculosis, for example, care must be taken to avoid emotional disturbances, since the patient is not allowed to engage in vigorous physical exercise and is thus denied an important natural means of working off his emotional tensions. Unless efforts are made to help the patient maintain a cheerful mood, a disease which is essentially organic may be intensified by emotional factors.

Physicians are currently recognizing the fact that "high-pressure, "go-getting" businessmen are especially prone to heart conditions. According to one report, coronary heart disease strikes these men seven times as often as it does individuals in the general population (Friedman and Rosenman, 1960). The coronary-prone person may often be recognized by such mannerisms as explosive emphasis on certain words when speaking, fist clenching during ordinary conversation, or attempts to hurry conversation by finishing another person's sentences. However, these behavior patterns do not necessarily occur.

There is evidence that the lie detector may be useful in identifying persons who are especially subject to coronary heart disease.

Twenty persons with coronary heart disease, seven persons with functional cardiovascular disease, and fifteen persons in normal health were tested while listening to a tape recording of interrupted monologues designed to cause irritation. The coronary patients were clearly differentiated from the other groups by respiratory changes and increased bodily movements (Friedman and Rosenman, 1960).

Physiological reactions to the same emotion-provoking situation vary widely among different individuals. The importance of earlier experiences in determining such reactions was indicated in a two-year study of Harvard students subjected to experimentally induced stress.

In some students, the heart and blood vessels behaved under induced stress as they would have had the students received an injection of adrenaline. These were

the students whose primary reaction to the stress was anxiety and fear or a feeling of anger directed toward themselves. In the other group, who tended to experience anger directed outward, the heart and blood vessels behaved as they do when a person receives an injection of noradrenalin.

When the students filled out a questionnaire concerning their childhood discipline, it was found that nearly all of the "anger-out" group had strict fathers who had played a dominant role in discipline. The "anger-in" group, on the other hand, for the most part had mild fathers who had usually shared equally with the mother in discipline or even allowed the mother to be dominant. This may indicate that control during childhood causes certain reaction patterns which remain fairly constant in later life (King and Henry, 1955).

Although further research is needed, this study indicates that even involuntary reactions to stress are influenced by a complex set of factors.

The General-Adaptation-Syndrome

A theoretical approach which helps explain psychosomatic symptoms is the concept of the *general-adaptation-syndrome*, developed by the prominent endocrinologist Hans Selye (1953, 1956). According to Selye's theory, the body's reaction under stress occurs in three major phases: the *alarm reaction*, the *stage of resistance*, and the *stage of exhaustion*.

1. The *alarm reaction*, sometimes called the *emergency reaction*, comprises the physiological changes which are the organism's first response to the application of a stress-provoking agent, or *stressor*. A stressor is anything injurious to the organism, whether physical (such as inadequate food, loss of sleep, bodily injury) or psychological (such as loss of love or personal security). The alarm reaction consists of various complicated bodily and biochemical changes which usually have the same general characteristics regardless of the exact nature of the stressor.

In an experimental situation, a large number of animals were subjected to a wide variety of stressful conditions including starvation, infections, poisoning, extreme cold, extreme heat, surgical hemorrhage, and

others. Regardless of the type of stressor, much the same general pattern of physiological change was observed (Selye, 1950).

This finding accounts for the similarity in general symptoms of people suffering from diverse illnesses—all seem to complain of such symptoms as headache, fever, fatigue, aching muscles and joints, loss of appetite, and a general feeling of being "run down."

2. If exposure to the stress-producing situation continues, the alarm reaction is followed by the *stage of resistance*, the second phase of the general-adaptation-syndrome. Here the organism seems to develop a resistance to the particular stressor which provoked the alarm reaction, and the symptoms that occurred during the first stage of stress disappear, even though the disturbing stimulation continues. Resistance to the stressor seems to be accomplished in large part through increased activity of the anterior pituitary and the adrenal cortex, whose secretions (*ACTH* and *cortin*, respectively) help the organism adjust to stress. The physiological processes disturbed during the alarm reaction appear to resume normal function at this stage.

3. If exposure to the injurious stressor continues too long, a point is reached where the organism can no longer maintain its resistance. It thereupon enters the final phase of changes related to stress, the *stage of exhaustion*. The anterior pituitary and adrenal cortex are unable to continue secreting their hormones at the increased rate, with the result that the organism can no longer adapt to the continuing stress. Many of the physiological dysfunctions which originally appeared during the alarm reaction begin to reappear. If the stressor continues to act upon the organism after this time, death soon occurs. Severe stress is usually relieved, however, before the stage of exhaustion is reached.

It has been suggested that instances of so-called "voodoo" death may grow out of the shock and terror experienced by the superstitious victim (Cannon, 1957; Richter, 1957). An illustrative account of death ascribed to overwhelming fear is the following story reported by a seventeenth-century traveler to the Congo.

A young Negro, lodging at the house of a friend, was served a dish containing fowl. He asked his host if it was wild hen, for that delicacy was banned for the young. The host replied, "No," so the boy ate his fill and then went on his way. A few years later the two friends met again and the older man asked the youth if he would eat a wild hen. When the boy said, "No," the man laughed and told him that he had eaten the forbidden food a few years before at his house. At this knowledge, the young man began to tremble and in less than twenty-four hours he was dead (Pinkerton, 1814).

An outpouring of adrenaline from the inner portion of the adrenal glands has been suggested as the cause of death in such cases. Adrenaline impairs the capillary walls so that there is a passage of fluid to the surrounding tissues; with the resulting reduction in the volume of circulating blood, the organism goes into a state of shock which leads to deterioration of the heart and nerve centers (Cannon, 1957). The relation, if any, between such sudden deaths and the general-adaptation-syndrome is not entirely clear.

Another interesting finding in connection with the general-adaptation-syndrome is that in building up resistance to a particular stress provoker, the organism apparently suffers reduced ability to resist other stressors. Thus mice exposed to extremes of cold appear to develop resistance to the cold but become unusually sensitive to X rays. Similarly, animals who learn to adapt to large doses of morphine become unusually sensitive to cold. The same principle seems to apply in cases of psychologically induced stress. A soldier in combat, for example, may become so well adapted to the stressor of physical danger that he shows no outward reaction of fear; but if another stressor is added, such as bad news from home, he may become physically ill. This theory helps explain the fact that in one case severe psychological stress produces severe physiological disorganization, whereas in another case no ill effects are noted.

The concept of the general-adaptation-syndrome has been exceptionally valuable in explaining psychosomatic disorders. In terms of its framework, many disorders can be viewed as the results of stress or of the physiological processes involved in adaptation to stress. The

value of ACTH and cortisone (a hormone produced by the adrenal cortex) in treating some of these diseases can also be understood. In effect, such treatment may be regarded as a way of helping the anterior pituitary and adrenal cortex maintain resistance to some stressor. The theory of the general-adaptation-syndrome promises to modify the treatment of both physical and psychological disorders.

One psychologist, after reviewing the work of Selye and others, summed up the situation as follows:

"Perhaps emotional reactions are basically constructive—defensive and adaptive. However, if emotional activity or reactivity is sufficiently frequent or prolonged or intense, it becomes maladaptive or destructive, leading to physiological aberration or structural damage to the organism, and even to death. Thus, an organism may be injured or destroyed by its own defenses." (Lachman, 1963, p. 247).

Pleasant Emotions and Health

There have been no studies comparing the health of persons who characteristically experience pleasurable emotions with the health of persons who do not. Because persons who are unhealthy (or think they are) go to physicians and subject themselves to intensive clinical and laboratory studies, we know a great deal about the effect of unpleasant emotions in producing ill health. But we have very little systematic experimental evidence on what happens at the other end of the scale.

A study has been made, however, of the relationship between psychological factors and the rate of healing after the stressful experience of a surgical operation.

In an attempt to determine the effect of preparatory communications designed to serve as "emotional inoculation" for patients, it was found that a little worry prior to an operation is apparently the ideal condition for producing positive reactions to the surgery. When they worry too much or not at all, patients tend to be less cooperative and more hostile and demanding, and healing is likely to take place more slowly (Janis, 1958).

HOW EMOTIONS DEVELOP

How does a man become the emotionally complex person that he is? What are the origins of his morbid fears, his daily annoyances, his sentiments of patriotism and loyalty? To what extent do these result from maturation and to what extent are they the product of learning?

Early Experimental Findings

Many strange superstitions have guided people's thinking on the question of which emotions are inborn and which are learned. It was once commonly believed that children have instinctive fears of many things—furry and feathery objects, fire, darkness, reptiles, and so on. ♦ Only within the twentieth century have psychologists systematically tested the validity of such ideas in an attempt to arrive at a scientific understanding of our emotional life.

Testing for inborn emotions. Experiments conducted by John B. Watson and the behaviorist school of psychology in the 1920's attracted attention to the problems of emotional development. Although his methods were not precise and some of his assumptions and conclusions have been considerably modified by later investigators, Watson made a significant contribution by challenging the then popular notion that most common emotional patterns are purely instinctive. For instance, a popular notion held that babies and young children instinctively fear furry objects.

Watson's subjects were babies four to five months old who had been hospital reared in virtual isolation from the numerous emotional stimuli encountered by babies reared in the average home. The babies thus experienced these stimuli for the first time under laboratory conditions, with trained observers carefully recording their responses.

In the first test of this series a lively black cat was shown to infants. The children invariably reached out to touch the animal's fur, eyes, and nose. When a rabbit was presented, the responses were essentially the same

except that a child often would grasp the ears in one hand and thrust them into his mouth. No evidence of fear was found in any of the subjects. When friendly Airedales, both large and small, were presented, the results were similar, except that with the large dogs little manipulatory behavior was observed. Since these children, with no previous opportunity to learn, showed no fear of any of the animals, Watson concluded that the prevalent belief in an instinctive fear of furry objects was groundless (Watson, 1926).

Other conditions which were popularly believed to provoke emotional reactions also failed to do so when experimentally tested. After exploring various stimulus situations and observing a number of infants, Watson decided that there were only three discrete, identifiable emotional responses in the young infant: fear, rage, and love. Fear, he found, could be elicited by loud sounds and loss of bodily support. Rage could be provoked by restraining bodily movement. The response of love was produced by stroking or manipulating various body areas. Watson's conclusion, then, was that the stimuli which elicit emotion *prior to learning* are decidedly limited.

Conditioning emotions in children. Watson and the behaviorists also demonstrated the great importance of conditioning in emotional development. We have already seen in our discussion of symbolic rewards (page 399) how children learn to seek previously neutral words and objects as rewards, because they become associated with the satisfaction of basic needs. Similarly, children learn to *fear* and *avoid* previously neutral objects which become associated with painful or unpleasant experiences.

Watson reported a now famous case of an eleven-month-old boy, Albert, a remarkably happy child who prior to any experiments was rarely seen to cry. After repeated tests were conducted to see that nothing but loud sounds and loss of bodily support would evoke a fear response in the child, an attempt was made to see

whether he could be conditioned to fear a white rat. The results of this experiment were unmistakably clear.

A previous test had shown that Albert had no fear of the white rat. At the beginning of the conditioning experiment the child was suddenly presented with the animal. He reached for the rat; just as his hand touched it, a loud sound was made by striking a metal bar behind the boy's head. This elicited a startle reaction, but Albert did not cry. He reached for the rat a second time. Again, just as he touched the animal, the bar was struck. This time Albert jumped violently and whimpered.

A week was allowed to elapse before any further conditioning trials were attempted. Then, on the first trial, the rat was suddenly presented alone without the sound. The child was hesitant in reaching for the animal and upon contact with it withdrew his hand suddenly. Several additional trials followed in which the rat was presented in combination with the loud sound. Each time, the boy exhibited startle responses. On the later trials he whimpered or cried. Finally the rat was again presented alone without the sound. This time the child began to cry immediately, turned from the animal, and crawled away rapidly (Watson, 1926).

Here is evidence of how a fear response can become attached to a stimulus that has previously been neutral or even a source of pleasure. In effect, new objects come to elicit emotional responses which originally are related to a very small number of objects and situations. By a process of stimulus substitution, the child learns to fear an ever increasing number of objects as he grows older and his experience widens to make his emotional life more complex.

Stimulus generalization. We saw in Chapter 6 that behavior learned in response to one stimulus may appear in response to similar stimuli also. Watson conducted further experiments to find whether a person who has been conditioned to fear one object will develop fears of similar objects.

Before he was conditioned to fear the white rat, Albert had been playing with fur muffs, false faces, rabbits, pigeons, and other similar objects without the slightest indication of fear. He was not allowed to see any such objects during a five-day period following his last conditioning contact with the white rat. On the sixth day he was tested again. When Albert was again presented with the rat, he whimpered and turned away.

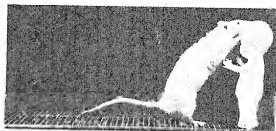
Obviously the conditioned response to the rat had carried over the five-day period. Albert was next shown, in order, a rabbit, a dog, a sealskin coat, cotton, wool, human hair, and a Santa Claus mask. Each of these stimulus objects now elicited negative responses, although the child's reactions were stronger and more pronounced to the animals and the fur coat than to the other objects, which bore less similarity to the rat (Watson, 1926).

Thus we see how stimulus generalization complicates the development of emotional responses. Notice that the degree to which Albert's fear response spread from one object to



◆ Many people learn to fear spiders, but it is now known that there is no instinctive fear of such creatures. This boy not only has no fear of spiders but has made pets of two tarantulas, giant spiders which are repulsive to most people.

■ Rats soon learned to get rid of the shock by striking at each other (left) and ignored the celluloid doll as long as another rat was available (center). But when placed in a cage with only the doll (right), they struck at the doll.



others was, in general, proportionate to the amount of similarity between the new objects and the rat.

Another example of stimulus generalization was shown in a laboratory study with rats.

In this study rats were trained to strike at each other as they do at the beginning of a fight. This was accomplished by placing two rats in an enclosure, the floor of which was a grid giving them an electric shock. Whenever they happened to approach each other in a sparring position, the shock was cut off. After a minute without shock the current was turned on again. Soon the animals learned to begin striking each other vigorously as soon as the shock began.

Then a celluloid doll was placed in the enclosure with the rats. The animals continued to strike at each other and not at the doll. But when they were placed in the enclosure one at a time with the doll, the rats struck at the doll. When a control group of untrained rats were placed one at a time in the enclosure with the doll and given a shock, only one struck at the doll, demonstrating that the tendency to strike the doll was the result of training. The striking response, learned in connection with other rats, had been generalized to include the doll (Miller, 1948). ■

Such experiments form the basis of the behaviorist theory that emotional life becomes complicated as a few basic emotional reactions spread—through learning—from one situation to others. The concept of stimulus generalization may account for situations such as that in which a child accustomed to getting his own way at home by tantrums tries the same tactics at school. It should also give you some insight into the familiar experience of disliking some

person upon first meeting him. A negative emotional reaction attached to one person through some unpleasant association can transfer to someone else who bears a resemblance to him, even though you are unaware of the resemblance and may not even be thinking of the original individual.

Emotional response to symbolic stimuli. An emotion-provoking stimulus need not be a real-life situation. It may be just a symbol, such as a spoken word or phrase, which represents some situation or activity. As the child grows up and learns to understand and use more and more words, these words take on emotional connotations. Some words become fearsome, others become pleasant, and still others become disgusting.

In the previous chapter we noted how the desire for social approval can lead to conditioned reactions toward or against certain symbols. If a mother shows displeasure and says "bad," whenever her child does something she disapproves of, the word *bad* will come to be associated with unpleasantness and disapproval. If the word *bad* is further reinforced with a slap or with the removal of some desired toy, it will become even stronger as a stimulus. Through the use of language, children may even come to fear nonexistent things, such as bogeymen and ghosts.

Words, however, are just one example of an infinite variety of symbols that can arouse an emotional response. The figure of a bear, a tiger, a badger, or even a fictitious creature like a Jayhawk may arouse warm feelings of loyalty in students from the University of California,

Princeton, the University of Wisconsin, or the University of Kansas, respectively. Or, at a homecoming game, the same symbol may produce hostile excitement in the members and fans of the opposing team. Thus, through the process of learning, symbols as well as objects may serve as stimuli which elicit emotion.

Maturation and Learning in Emotional Development

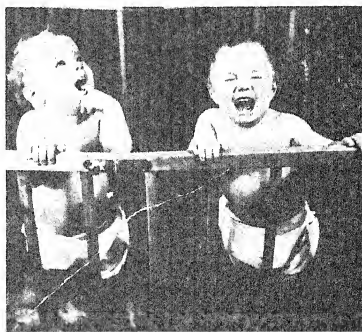
Watson and his followers were so intent on studying the environmental factors in emotional development that they neglected the role of maturation in determining the growth of emotional complexity. Other experimenters have discovered that even the conditioning of emotional responses is not quite so simple as the results of the early studies seemed to indicate. Criticisms of Watson's work have centered on the following main points: (1) the nature of the stimulus is more important than Watson realized in determining whether or not an individual can be conditioned to respond to it emotionally; (2) maturation as well as learning is involved in the growth of emotional complexity; (3) individual differences in patterns of emotional response are greater than Watson realized; and (4) the situations that will evoke emotion prior to learning are not limited to those specified by Watson. For example, fear can be induced not only by loud sounds and loss of support but by almost any sudden, intense stimulus.

The nature of the stimulus. Watson believed that children could be conditioned to fear any object, but later experiments have shown that this is not the case.

One psychologist attempted to condition a child to fear a pair of opera glasses and a caterpillar by associating each of them with the sound of a loud whistle. The fear response was invariably aroused by the whistle and, through conditioning, by the caterpillar. But it never became conditioned to the opera glasses (Valentine, 1930). Another psychologist found it impossible to condition the fear response to biologically neutral stimuli such as a cloth curtain, wooden blocks, and rings (Bregman, 1934).

Apparently there is a hierarchy in emotional stimuli. At one end are such things as sudden loud sounds which will bring a fear response the first time they are presented—stimulus situations which infants fear “instinctively.” Next, there are such objects as rats, snakes, caterpillars, and pieces of fur, which children can be conditioned to fear in a few trials. Then there are neutral objects, such as opera glasses and wooden blocks, toward which fear cannot easily be built up. Thus, the nature of the stimulus itself is seen to have a definite limiting effect on the conditioning theory of emotional development.

The maturation factor. Although learning is undoubtedly important in adding to the complexity of our emotional responses, many studies have indicated that maturation underlies the emergence of many emotional response patterns. Certain emotions not observable in infancy appear almost universally at a later age. Also, in emotional patterns as in other types of development, maturation brings increasing differentiation and specificity of perception and behavior.



▲ These twins are reacting to seeing a favorite toy held up out of their reach. Though only nine months old, their emotional reactions are quite different. One shows pleasure and interest, while the other cries in frustration.

Since 1873 psychologists have known that there is a critical period during which fear appears in chicks. Chicks which had hoods over their heads from the time of hatching were readily imprinted (see p. 192) to the experimenter if the hoods were removed on the third day. However, if they were not unhooded until the fourth day, the chicks tried to escape (Spalding, 1873). A few years later, the psychologist and philosopher William James noted that calves as well as chickens tended to show an "instinct" to follow for a few days, after which they would run away instead (James, 1890).

Recent experiments have confirmed these early findings and added to them.

Although chicks show a maximum of fearfulness toward a wide variety of new stimuli on about the fourth day of life, they display only a mild caution in nonthreatening situations by the fifth day. Chicks exposed to black circles or triangles during the maximum fear period later spent significantly more time near an unfamiliar form than near the one that they had seen during their fearful period, whereas chicks exposed to the forms after this period showed no preference (Gray, 1958).

Several studies have indicated the great importance of maturation in the development of fears in children.

In one study, observations were made of the crying behavior of sixty-one infants. The babies were put through a series of test situations every month during the first year of life, with special attention being paid to crying from fear in strange surroundings. This type of fear behavior occurred when the child was brought into strange rooms or when he was taken from the mother by a stranger. The results of these successive monthly observations showed that crying from fear of strange surroundings is absent during the first two months but that by the age of ten months about a quarter of all the baby's crying responses are attributable to fear of strange surroundings (Bayley, 1932).

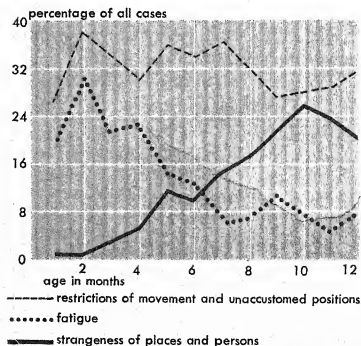
Why should crying from fear of strange surroundings have become relatively more frequent as the infants got older? One explanation might be that the babies became conditioned to fear new situations. This is possible but not probable. Care was taken not to harm the in-

fants or in any way permit the association of strange persons and situations with already-present fears. A more probable explanation is that increase in age brings an increase in visual acuity and intelligence and, consequently, a clearer perception of whether surroundings and persons are familiar or strange.

Additional evidence comes from a study in which both children and adults were suddenly confronted, individually, with a large and active snake. Children under two years of age showed no fear, but by three or three and a half, caution reactions appeared. In children over four, definite fear reactions were observed. Fear was more pronounced in adults than in children (Jones and Jones, 1928).

Here, too, the behavior probably reflects a general maturation with a resulting increase in sensitivity and discrimination and a backlog of experience to draw on. A baby of twelve months probably will not be especially surprised to find a snake in a black box, for example, because he has not had enough experience to know that this is unusual. A typewriter in a box might seem every bit as strange to him. As

CHANGES IN CRYING BEHAVIOR OF INFANTS



the child learns what to expect in given situations, however, he will tend to become fearful of things that are unfamiliar or fail to fall into the expected pattern. Our emotional reactions, then, are apparently shaped both by our experiences with our environment and by the maturational level of our perceptual and intellectual capacities.

Differentiation of emotions in infancy. The differentiation of emotions during the first two years of life has been clearly described in an extensive study of the emotional behavior of sixty-two infants in the Montreal Foundling and Baby Hospital. Daily observations were made of the infants' emotional behavior, and careful records were kept not only of their responses but also of the conditions by which they were elicited.

It was discovered that as early as the second week after birth certain strong stimuli give rise to the generalized response of excitement. This is the only type of emotional response apparent during the first few weeks and is regarded as the original emotion from which all other emotional patterns develop. At an early age, general excitement becomes differentiated into *pleasant* and *unpleasant* emotions, although it also continues to appear in undifferentiated form.

Among the *unpleasant* emotions, *distress* can be distinguished by the time the baby is three weeks old. It is elicited by unpleasant stimulus situations, such as hunger or the discomfort of wet diapers. According to these studies, *distress* later becomes differentiated into the other unpleasant emotions of anger, fear, disgust, and jealousy.

By the fifth month the baby's *distress* may give way to unmistakable anger reactions when some interesting activity is interfered with. Disgust reactions also are clearly recognizable during the fifth month of life. These may be elicited by unaccustomed foods.

Fear reactions are clearly observable by seven months of age and become more marked with the passage of time. The fear pattern may be evoked by the presence of a stranger or almost any unexpected, strong stimulus.

Between the fifteenth and eighteenth months, the reaction of jealousy appears. When the attention of familiar adults is withdrawn from a baby, and particularly when it is bestowed upon another, a violent jealousy reaction may occur. Jealousy appears to have elements of both fear and anger. It is usually evoked by

the actions of adults rather than of other children, except as another child is the recipient of attention from some adult.

The first recognizably *pleasant* emotions do not emerge clearly until several weeks after the appearance of *distress*. The baby under a month old is either calm and quiescent or excited. By the second month the baby smiles fleetingly when he receives loving attention. By the third month the emotion of delight has become quite clearly differentiated. By the seventh month, the baby shows a typical reaction of elation when he succeeds in manipulating some toy or grasping an object beyond his reach. Learning to walk, a little later, is a source of great elation.

By eleven months of age, the average baby shows many signs of love or affection for adults. At first, affection is evoked only by familiar adults, other babies being ignored. By the fifteenth month, however, babies show definite affection for each other. By the eighteenth month the affectionate reaction to other babies and to adults becomes selective, certain individuals being preferred. Although at this age babies show a great deal of affection for each other, they continue to hit each other when the situation arouses anger (Bridges, 1932).

The Montreal studies and other careful observations of the emotional patterns of babies show no evidence of the emotion of shame. Evidently it is absent in early life—yet it is common to older children and adults. The reason young children have no sense of shame is not clear. The situations that provoke shame vary widely in different cultures. People are ashamed of the things of which their particular culture disapproves. This evidence would seem to indicate that shame is learned and is basically a fear reaction. Another hypothesis is that shame is a native emotion which appears as a result of maturation and that only the shame-provoking situations and the forms of expression are learned. Thus far, psychologists have not adequately tested either hypothesis because of the difficulty of isolating the two factors of maturation and learning. Regardless of how shame originates, however, the differences in the ways it develops in different cultures indicate the manner in which social experience can complicate emotional behavior.

The diagram shows how emotions typically change through life from the undifferentiated response of the infant, through the complex

and well-differentiated emotions of the adult, to the more constricted response of the aged person. ♦

Emotional Development in Childhood

The infant's responses to emotional tension, either pleasant or unpleasant, are usually vigorous and uncontrolled, regardless of the strength of the stimulus. Although his emotional outbursts usually last for only a short time, they are intense to a degree seldom found in later periods of development.

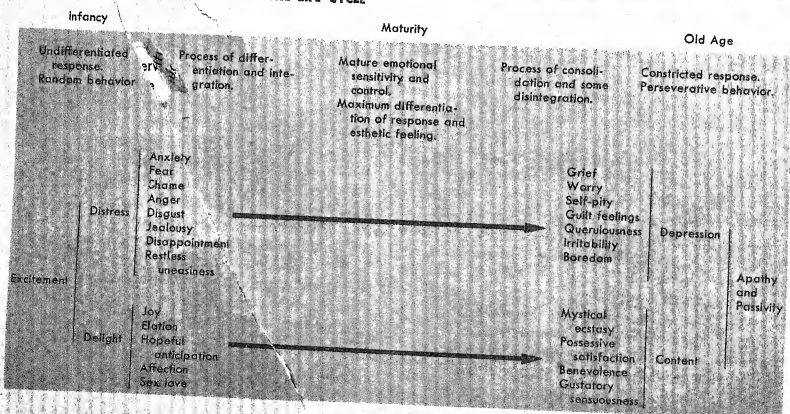
Further differentiation of emotions. Lack of control continues to characterize the emotional responses of early childhood, but the variety of response increases, and a widening number of situations become provocative. The child becomes angered, for example, not only by physical frustrations but also by the increasing number of social restrictions he encounters as his environment expands. Crying is still a common

response, but it is replaced in some situations by other methods of protest—shaking the head, saying “no,” disobeying.

Young children are most likely to respond emotionally to tangible events. They are angered by the frustration of their immediate wants and find joy in the immediate and the obvious—their own accomplishments, funny sounds, physical incongruities. Their fears are more often of tangible than imaginary objects and are aroused chiefly by things which seem frightening because they are unfamiliar.

As the child develops the capacity to perceive things more accurately and to remember and anticipate events, he begins responding emotionally to events and situations as signs of possible fulfillment or frustration in the future. This change is accompanied by the appearance of a new emotion—worry. Although the child worries about an increasing number of things as he gains experience, he loses many of his previous fears, which his experience has taught him were unfounded. During later childhood the most common sources of worry are family

CHANGES IN EMOTION DURING THE LIFE CYCLE



and school problems, personal and social adjustment, and health (Pintner and Lev, 1940).

The beginnings of emotional control. During early infancy most of the child's self-centered demands for immediate satisfaction are met. But soon he reaches the level of physical and psychological development where he must learn to bear frustration—to give up complete satisfaction and begin meeting the demands of his particular culture. One lesson he learns is that violent, uncontrolled emotional expression is not acceptable. Thus while a growing number of social restrictions increase his emotional tensions, they also impose rules on the ways he can release them. Fortunately, by sacrificing some of his demands, he is usually able to gain the positive emotional satisfactions of approval, praise, attention, and affection.

Knowing that emotional control is more difficult for the child when his hopes and expectations have become firmly set upon something he cannot have, the wise parent tries to keep such frustrating situations to a minimum, providing legitimate alternatives where possible, and structuring the situation in such a way that the desired behavior will bring satisfaction to the child. To do so is particularly important in early childhood, when the child should be developing a healthy self concept. He needs to feel he is a lovable and acceptable person if he is to develop the confidence he needs to become a productive, responsible member of his group.

✓ Emotional control is not easily achieved, and outbursts continue to occur with fair frequency during much of childhood. These may take the form of boisterous laughter, rough-and-tumble play, or a temper tantrum—depending upon the immediate stimulus and on what kind of behavior has brought reward in the past.

Usually, as they grow older, children gain steadily in their ability to express their feelings less directly, often by verbalizing them. Instead of kicking and screaming when he is angry, the older child may vent his wrath verbally or even take action to remove the source of difficulty. The same restraint of expression also becomes characteristic of his pleasant emotions. He laughs less often and less boisterously than when he was younger, but he smiles more of-

ten. He becomes reticent about displaying his affection openly but learns new ways to express his love—by seeking out the loved person, for example, and attempting to please him. Emotional control, in other words, is not so much a matter of suppressing the emotions as of finding approved ways of expressing them.

True emotional maturity also involves the development of a number of emotional responses which are not present in early childhood. During middle childhood (roughly ages six to twelve), for example, the individual normally begins to develop emotional attitudes toward such cultural values as the golden rule, democracy, and human brotherhood. Similarly, emotional reactions to esthetic experiences become increasingly important during childhood years. Creative expression is an excellent outlet for strong emotions, and appreciation of the great works of art and literature also plays an important role in the emotional life of the mature individual.

Emotional adjustment during middle childhood depends, too, on the child's ability to meet the usual developmental tasks of this period. These include, as we have seen (p. 102), developing the basic school-taught skills, learning work habits, and learning how to get along with age-mates as well as with authorities outside the home.

Needless to say, the school plays an important part in children's emotional development. Besides enabling children to develop the competence they need for self-esteem and confidence, teachers can provide children with many experiences that will stimulate the development of mature emotional patterns and a mature set of values and loyalties and can help children learn to put these values and loyalties into practice (Prescott, 1938).

There are also many ways in which the school can help children learn to manage troublesome emotional tensions (Prescott, 1957). Participation in active games and creative activities does much to release emotions in desirable ways. The feeling of participation and belonging which the child can attain in school may do much to help his emotional adjustment. Furthermore, the sympathetic help of a good teacher may aid in the adjustment of a child who gets too little love at home.

Emotional Behavior During Adolescence

Adolescence in our culture is a time of heightened emotional behavior. Although the explanation for this may rest partly in physical and glandular changes, social factors are probably more important. In our society adolescence brings changed and uncertain status. One psychiatrist has called the years from twelve to eighteen the "not quite" age, because individuals of this age are not quite children, not quite adults, and not quite sure of themselves (Lowrey, 1952).

The adolescent's uncertainty of his social role and of his own feelings gives rise to the common problems experienced at this age—parent-child conflicts, "puppy" love, crushes, and strong peer groups or "gangs." An important element in each of these is the adolescent's search for ways to express his independence without sacrificing his security. Since his family is usually slow to accept him as "grown up," he leans heavily on others—particularly those of his own age group—for support and approval. At this age nothing is quite so likely to produce worry and depression as the feeling of being unlike others, of being an "oddball," of being left out of things. Boys and girls who lack a feeling of secure status in their homes are more likely to be influenced strongly by the beliefs and activities of their "gang" than are those who have satisfying relationships within their family (Crane, 1955).

The problem of sex is often especially difficult for teen-agers reared in our culture. After puberty, hormonal secretions and other physiological changes give rise to new and often intense sexual feelings. However, numerous other factors also enter into the problem of adolescent sexuality (Reevy, 1961). Sexual interest is modified through learning of various kinds. Such general influences as rural or urban upbringing, cultural mores, and socioeconomic level of the family combine with more specific influences such as the practices of age-mates and the specific teachings acquired in the home or in sex education courses. Religious belief or the general philosophy of what constitutes a "good life" often helps to determine what forms of sexual expression the individual will or will not adopt.

It is apparent that the social conflicts and uncertainties of adolescence contain the ingredients of emotional stress. One psychologist has described the heightened emotionality of adolescence, particularly of the early and middle teens, in terms of five major characteristics: (1) intensity; (2) lack of control; (3) lack of consistency, or a tendency to shift rapidly between extremes of pleasant and unpleasant emotion; (4) prevalence of moods; and (5) the growth of values—emotions with intellectual associations—such as patriotism, family and group loyalty, and reverence (Hurlock, 1953).

The emotional expression of the adolescent differs from that of either the infant or the young child. The adolescent has usually learned to verbalize his emotions rather than to express them physically. He has also adopted some fairly stereotyped patterns of response—he mopes, giggles, looks awkward, and "blows off steam" in much the same manner as his contemporaries. And finally, although the adolescent is subject to somewhat unpredictable "ups and downs" of emotion, his emotional reactions tend to last longer than those of a child—unless they are interrupted by another stimulus which provokes a different emotion.

One reason why boys and girls of this age experience so many moods is that they tend to be preoccupied with themselves and with the many new problems peculiar to their age. Another reason is that adolescents, facing adult expectations for the first time, feel inhibited about expressing their emotions. Their old patterns of response no longer seem appropriate, but they have not had time to develop satisfactory new ones.

In most cases, the heightened emotionality of early adolescence has started to taper off by the late teens. Older adolescents experience some new tensions, of course, as the result of having to think seriously about such major decisions as work and marriage, but most of them by this time are well on their way toward achieving emotional maturity.

Adulthood and Emotional Maturity

When the individual is in his late twenties or early thirties, he normally has solved most of

his major problems of adjustment. He has made a good start in his life work and probably has chosen a spouse and started a family. These factors contribute greatly to making adulthood a period of relative emotional calm. Middle age, of course, requires new adjustments—as children grow up and leave home, physical vigor decreases, and the prospect of retirement looms larger. Successful adjustment to the problems of middle age is a sign of emotional maturity.

Richness of emotional experience. The emotional behavior of adults is richly varied and usually is channeled more usefully than at any other time of life. The mature individual reaches maximum sensitivity to his environment and is capable of keen esthetic appreciation and other refinements of emotion. Wise adults make the most of their varied capacities for emotional experience by developing a wide range of interests. Instead of devoting themselves exclusively to their children, they take up sports, hobbies, community activities, and other interests. Thus they are not at a loss when children leave home or when regular business activities cease. Equipped with varied interests, they are prepared to meet the new problems that old age will bring.

Everyday emotional experience. The emotions in the adult's exceedingly rich repertoire vary considerably in the frequency with which they are experienced. The strong emotions such as anger and elation are considerably less important in daily living than the nagging worries and petty annoyances that beset us. If you were to make a check list of the number of times during the past week that you consciously experienced various emotions, your tabulations would very likely show the highest incidence for worry and mild annoyance.

Worry is essentially a mild fear reaction associated with a future event which may or may not take place. College students report that worry usually comes in the evening during the study period. Typically it lasts two or three hours, according to students' reports, and is experienced more often during the middle of the week than on week ends, when students tend to relax and "forget their troubles." Many college students report that they become so worried

during an examination that they forget simple facts, dates, and formulas that they have studied thoroughly. Although these reports are sometimes mere alibis for failure, emotional "blocks" certainly do occur in taking tests. They are often worsened by the action of drugs such as benzedrine, whose effects have many points of similarity to those of adrenaline.

A controlled study of the effects of test anxiety on performance showed that highly anxious students tend to do less well on an examination than they can do when tested on the same material under more relaxed conditions.

On the evening of the day they had taken the first hour examination in psychology, the subjects, 100 college women, met in small informal groups to take an equivalent examination. They were told that their scores on this examination would not affect their course grades in any way. The experimenters did everything possible to minimize anxiety and maintain a relaxed informal atmosphere.

Students of average ability who showed high test anxiety, as measured by a Test Anxiety Questionnaire (Mandler and Sarason, 1952) did better on the evening examination, while those of low test anxiety did better on the regular one (Paul and Eriksen, 1964).

Annoyance is a mild form of anger. Usually it is directed against some other person and, like worry, it is most likely to occur in the evening. It is typically of short duration, lasting on the average about twenty seconds. When it passes, it leaves no noticeable after-effects. Anger has about the same characteristics as annoyance except that it is more intense, lasts longer, and is more likely to motivate a person to action.

Moods in daily living. Usually an emotion is fairly brief, although subjects have reported outbursts of anger lasting as long as two days. Long-lasting emotional states—whether involving anger, fear, elation, or some other emotion—are usually called *moods*. A mood is generally less intense than an emotion.

Moods vary with the day of the week and the hour of the day as well as with the seasons.

Two surveys of the moods of male college students agreed essentially in finding that students feel "bluer" during the first and last half-hours of the day than at

other times; that they feel lower on Mondays than on any other day of the week; and that happiness of mood is highest in spring and summer, lower in the fall, and reaches the bottom during January, February, and March (Springer and Roslow, 1935; Cason, 1931).

In a more recent study the mood fluctuations of college women were examined.

Fourteen girls kept records of their moods for a period of forty-two days, using a ten-point self-rating scale daily. They also took two sets of personality tests, one when they were depressed and one when they felt elated. In general, these tests revealed that during depression the self concept is more unfavorable and appears to be further from the ideal self than during periods of happiness. Individual fluctuations in mood were quite irregular and showed no clear periodicity, except that depression usually occurred during the days just prior to menstruation. The average mood tended to be happy, with depressed periods of short duration (Wessman, Ricks, and Tyl, 1960).

The implications of these and similar findings for daily living are that it is natural to experience daily and seasonal fluctuations in moods and that there is no cause for worry when they occur. If the fluctuations come rapidly, however, or if the difference between "up" and "down" moods is extreme, the individual should probably consult a qualified counselor.

Emotional control in adulthood. Perhaps because of his greater experience, the mature adult is indifferent to many stimuli that gave rise to childish or adolescent emotionality. He is not so readily angered by minor frustrations, nor are his feelings so easily hurt. More important, when his emotions are provoked he is usually able to defer any overt response until an appropriate time and then choose an appropriate manner of responding.

Although society imposes the need for controlling the expression of emotional tensions, the individual is left with the problem of learning how to exercise that control and especially of finding constructive channels of expression. Some adults never achieve real control and as a result have unsatisfactory social relationships—with their families, with their co-workers, with their friends. Others "control" their emotions

by bottling them up and refusing to express them at all, usually with unfortunate results for their physical and mental health. The mature individual, on the other hand, controls his emotions without denying them. By doing what he can to maintain good health, get adequate rest, choose congenial work and surroundings, avoid unnecessary pressures, set realistic goals, and develop a sense of humor, he goes a long way toward avoiding unpleasant tensions. He also develops healthy and acceptable outlets for releasing emotional tensions—hobbies and varied interests, sports, and manual work are but a few of many possibilities. Such outlets are an important factor in emotional health, for although man can learn to control the expression of his emotions, he can never eliminate them.

Emotional Problems of Old Age

At best, old age is likely to be a time of deprivation. Family relationships change, occupational status is lost, and friends die. Decreased physical vigor forces the elderly person to give up many activities that formerly brought satisfaction. And all too often financial resources become so limited that they are a cause of active anxiety. With so many frustrations, it is little wonder that older people have a reputation for being irritable.

Along with specific emotional deprivations, most elderly people experience a general lessening of emotional excitability (Banham, 1951). The older person has the asset of long experience, which enables him to keep a broader perspective and to be better prepared for emergencies and therefore less frightened by them. When he does experience a severe emotional shock, however, he is likely to become exhausted by it and to remain depressed for some time. The young person, on the other hand, usually recovers from such an experience quickly and with enough surplus energy to pursue other interests, which further help him to regain his equilibrium.

Another common characteristic of the emotional life of the aged is rigidity. Elderly people usually find it hard to adapt to new conditions and tend to respond to new emotional situations with whatever behavior has served them

well in the past. Sometimes this works, but often the old pattern of behavior is inadequate in the new situation.

Undoubtedly you have known elderly persons who retained their interest in life and were flexible in their reactions. A person who plans

ahead and develops as many interests as possible can do much to avoid the narrowing of life that might otherwise come with old age. He can enjoy his closing years by making the most of his freedom from constant daily routine and responsibilities.

ADJUSTMENT IN MARRIAGE

For most people, adjustment in marriage is a fundamental facet of emotional maturity. Marriage gives the partners an opportunity for the satisfaction of their needs for companionship, affection, and sexual expression. In our society, marriage and the home provide the ideal situation for procreation and the rearing of children. The family is also our basic economic unit.

Choosing a Marriage Partner

Marriage involves the close cooperation of two persons. Success in marriage is a matter partly of *finding* the right person and partly of *being* the right person. Some people, as shown by their multiple divorces, seem to lack the aptitude, skill, and temperament required for marriage. In other instances, two persons who are poorly suited to each other may find happiness with different marriage partners. And two seemingly incompatible persons can often learn to get along with each other. In this case, being the right person is a matter of *becoming* the right person.

Some of the important personality characteristics that go to make up the "right person" are shown in an analysis of responses from 221 college students. According to this study, college men prefer wives younger than themselves, superior to them in physical beauty, equal in intelligence and sexual strength, and inferior in education and physical strength. College women, on the other hand, prefer husbands equal to them in physical charm and sexual strength, but superior in intelligence, educa-

tion, and physical strength, and older than themselves (Singh, 1964).

Education. While it is true that most men marry girls who have had less formal education than they, the more educated a man is, the greater his tendency to select a wife of above average education. Similarly, the more educated girl is likely to marry a man of superior education.

In one study in which 559 college students were asked whether they would prefer their mates to have less, more, or the same education as themselves, 60 per cent of the men preferred equal education and 3 per cent wanted the wife to have less (Komarovskiy, 1946). In a more recent study of 559 students, 78 per cent of the men wanted equal education and 17 per cent wanted the wife to have less (Baber, 1953). In neither study did the girls want husbands with less education than they. Instead, over half the girls wanted their husbands to have more education than themselves.

Here is a social pattern so sharply defined that to deviate from it by marrying a person greatly different in degree of education would appear to jeopardize the chances of happiness.

It has also been found that men and women with a high level of education have a higher level of marital adjustment than those with little education (Locke, 1963).

Religion. The effect of differences in religion upon success in marriage is a topic of considera-

ble concern to college students. In these days of social mobility and contact in schools, jobs, military service, and social life, it is inevitable that men and women of different religious faiths will meet and become attracted to each other.

Among Protestants, differences between denominations appear to have little effect on choice of marriage partner. In a study of religious social distance among a large sample of rural youth in Pennsylvania, the hypothesis was that marriage choices would vary directly with the similarity of the denominations to which the partners belonged. The various sects were ranked by theological experts on the degree of similarity in their structural formalization. Marriage outside the denomination exceeded marriage within the denomination for all the religious bodies represented, except Roman Catholics and Mennonites. Moreover, the pattern of choices did not reflect the similarity between sects but simply varied with the relative availability of possible spouses in the various denominational groups (Bealer, Willits, and Bender, 1963).

With the rate of interfaith marriage as high as it is, the question of the relationship between interfaith marriage and happiness in marriage becomes an important one. Fortunately, most studies do not find that religious differences are a major source of failure in marriage (Locke, 1951; Monahan and Chancellor, 1955). Apparently religious differences that would be great enough to disrupt a marriage are generally great enough to prevent the marriage from ever taking place.

Age discrepancies. Most people prefer to marry someone of approximately the same age, with the female partner a little younger than the male.

In a study in which college students were asked if they wanted their mates to be older, younger, or the same age as themselves, only 24 per cent of the men wanted a wife the same age, while 75 per cent wanted the wife to be younger. Their median preference was three years younger. The girls expressed an overwhelming (94 per cent) preference for an older husband, their median figure being five years. However, they did not want the husband to be more than ten years older (Bober, 1953).

Many people believe that marriages between persons of widely differing ages are destined to turn out badly. It has been found, however, that even when age differences between husband and wife are considerably larger than average, this factor is not related in any important degree to happiness in marriage (Locke, 1951).

Factors in Marital Happiness

Marital adjustment depends on no single factor; it results from the interaction of the total personalities of the partners, and resources and pressures from the environment also play an important role. Some of the many factors which have a bearing on happiness in marriage will be discussed below.

Early vs. late marriage. One factor commonly believed to affect the success of marriage is the ages of the partners when they marry. Very young people are supposed to be too irresponsible and older people to be "too set in their ways." Is there any basis for these beliefs?

In a comprehensive study, 525 persons who were divorced or in the process of obtaining a divorce were compared with 404 happily married persons. In this study the optimum marriage age for women was found to be between twenty-one and twenty-nine years. Those marrying before or after this age had a poorer chance for happiness. The best age for men was found to be between twenty-four and twenty-nine years (Locke, 1951).

Is it possible that persons who are emotionally immature are the ones to whom early marriage appeals most? In testing this hypothesis, one investigator found that girls who had married within five years of high-school graduation appeared to have greater feelings of "ego deficiency"—that is, a greater tendency to withdraw or to depend upon others—than did carefully matched controls who were still single at the end of that period (Martinson, 1955).

If early marriage tends to be a sign of emotional dependency, as this finding suggests, it is not surprising that many early marriages fail. It is interesting in this connection that Americans are now marrying at younger ages than pre-

viciously, as shown by the following data from the 1960 U.S. census:

	1890	1960
Average age of grooms	26.1	22.8
Average age of brides	22.0	20.3

On the question of whether late marriages are more or less likely to be successful, the findings have been somewhat controversial. One investigator studying a group of divorced couples found that women who had married at thirty or older and men who had married at thirty-five or older had the shortest mean duration of marriage (Tarver, 1951). Other studies have concluded that beyond twenty-one the age at marriage is of little or no importance (Terman and Bittenwieser, 1935; Burgess and Cottrell, 1939).

Obviously the problem of marriage age is a complex one requiring further study. Thus far it seems safe to conclude that marriages contracted before the partners are twenty-one are more likely than average to fail, but on the question of whether there is a *best* age for marrying, the evidence is inconclusive.

Courtship. The courtship period has long been regarded as very important to success in marriage. During this period a couple has the opportunity to become well acquainted, to discover areas of agreement and disagreement, to learn the necessity of cooperating. What happens when this period of getting acquainted is cut short and a couple marries without having really tested their ability to get along?

Length of engagement was one factor included in a comprehensive study of divorce. In most instances the couples had known each other a year or more before marriage, and the longer they had been acquainted the longer the marriage lasted. However, the actual engagement period was shorter than six months in 71 per cent of the cases and nonexistent in 19 per cent. In general, longer engagements resulted in longer marriages even though the marriage ultimately failed. (Goode, 1956).

One early study of the relationship between marital happiness and premarital sexual activity found a low positive correlation between non-

virginity at time of marriage and the happiness of the marriage (Terman, Bittenwieser, Ferguson, Johnson, and Wilson, 1938). There have been very few good studies on this important question, however, and the reluctance of many people to give accurate information is an important obstacle to research. In this area, as in that of interfaith marriage, we lack sufficient knowledge to permit generalization.

Environmental factors. Marriages are more likely to succeed when the husband and wife are of similar social status and when the couple tends to move upward rather than downward on the social scale (Roth and Peck, 1951). Adequate income, savings, low indebtedness, and steady employment are also positively related to marital success (Williamson, 1952).

Statistics indicate that the divorce rate is high immediately after a war; then after a year or two it drops quite rapidly. This was true in the periods following both World War I and World War II. Three hypotheses help to explain post-war marital instability. The first is that the spirit of the times is responsible: the general unrest and uncertainty existing in wartime are conducive to mismatings and hence to divorce. The second is that during wartime there is a shift of values toward emphasis on physical attributes, hero worship, and immediate gratification which leads young people to make wrong choices. The third hypothesis is that the shortness of the engagement period is responsible for the instability of such marriages. Probably all three factors operate (Terman, *et al.*, 1938; Burgess and Cottrell, 1939).

Happy marriages seem to run in families (Locke, 1951; Burgess and Wallin, 1953). Happily married parents usually give their child the kind of upbringing that ensures his ability to get along in marriage when he becomes an adult. Children who come from unhappy homes, on the other hand, are more likely to have marriage failures of their own.

Children. The desire for children seems to be positively correlated with happiness in marriage, but the actual presence or absence of children apparently is not (Locke, 1951). The timing of the birth of the first child, however, does have a bearing on marital happiness.

No matter how well a couple have come to know each other during their engagement, they are almost sure to encounter a number of adjustment problems in the early months of marriage. If pregnancy, which often causes the wife to feel unwell or brings financial worries, occurs too soon, marital happiness may be jeopardized. The frustration of feeling "tied down" by the care of an infant intensifies the strain of learning to live together, and may be a contributing factor in early divorce.

Data obtained in a recent cross-cultural study support this common-sense observation. Marriage records were matched with birth records of children born to each couple, as well as with divorce records, for three cultural groups. The cultures used were the sexually restrictive Mormons in Utah, an intermediate group in Indiana, and the more sexually permissive culture of Copenhagen, Denmark. In all three cultures, the shorter the interval between marriage and the birth of the first child, the higher the divorce rate (Christensen, 1963).

Personality factors. As might be expected, emotional stability is very important to success in marriage. The happiness of one marriage partner has been shown to be significantly correlated with the emotional stability of the other partner (Terman *et al.*, 1938). More recently, neuroticism in husbands and wives has been found to be significantly correlated, and emotional disturbance in childhood has been found to be correlated with unsatisfactory marital adjustment in adulthood (Pond, Ryle, and Hamilton, 1963). However, the pattern of the personalities involved is also important. We have all known well-adjusted individuals whose personalities clashed if they were together very long.

When one person's personality needs complement those of the other, such clashes are largely avoided. There is considerable evidence that most individuals tend to select marriage partners whose needs or personalities complement their own (Winch, 1955; Ktsanes, 1955). For example, a person who needs to dominate others will be attracted to a partner with a strong tendency to depend upon someone else, and vice versa. The selection process is more complicated than a simple attraction of opposites,

however, for each person has more than one need, and needs differ in intensity.

A test of the effect of need complementarity was made in a recent study in which fifty-five paid volunteer couples served as subjects. From a forced-choice need questionnaire which they filled out, scores were obtained for the complementary needs of Succorance (need to receive affection) and Nurturance (need to give affection). A visual discrimination task was used to determine to what extent subjects were influenced by their spouse's judgment. As hypothesized, husbands whose Succorance need was similar in strength to their wives' Nurturance need showed a strong tendency to be influenced by the wife and conform to her judgment (Katz, Cohen, and Castiglione, 1963).

It may not even be necessary for couples to understand each other's personalities in order to be happy.

In one experiment, couples were asked to state their perception of themselves and of their mates and to predict their mate's perceptions of both. All conclusions were checked against results obtained by random pairing of subjects' responses with those of other husbands or wives taking part in the study. Happy couples' predictions of each other's responses showed no greater correlation with the actual responses of their mates than with the responses of the randomly selected controls. An interesting side finding was that happiness was greater when husbands tended to conform to a stereotyped concept of what a husband should be. This was not important in the case of wives (Corsini, 1956).

Although it is popularly believed that a married couple should share many interests, studies show that the number of common interests is not important. The type of interest is what matters. The wife need care nothing for poker or boxing, and the husband need have no interest in cooking or interior decoration. In fact, one study found that the sharing of such individualistic interests was actually unfavorably related to marital happiness (Benson, 1955). Happiness is positively related, however, to the sharing of *familistic* interests—interest in the home and the children, demonstrations of love, and religious interests (Benson, 1952, 1955; Frumkin, 1954).

In general, married couples tend to agree in their attitudes on important topics. Interestingly, the partners assume an even greater similarity than actually exists (Byrne and Blaylock, 1963).

These results were confirmed in a more recent study, involving sixty married pairs, which also found that the amount of assumed similarity was positively associated with marital happiness. The subjects included twenty-four couples who were clients at a family service agency and thirty-six couples who were parents of children at an elementary school and who were selected to match the first group in social characteristics. The assumption that the latter group would be better adjusted maritally was borne out by data obtained during the study.

Husbands and wives were interviewed individually to determine their attitudes toward family life. They were asked to rank the relative importance of nine marriage goals and eleven marital communication topics and to describe the couple's real and ideal behavior in several areas of marriage—decision making, frequency of communication, frequency of sexual relations, and the like.

The correlation between husbands' and wives' marital satisfaction scores was .45, and the mean satisfaction score for husbands did not differ significantly from the mean for wives. Correlations between marital satisfaction and assumed agreement are shown in the table.

	For Husbands	For Wives
Communication topics	.39	.19
Marriage goals	.45	.29

Agreement about specific topics husbands and wives should discuss was greater than about the more vague general marriage goals (Levinger and Breedlove, 1966).

Cooperation and communication. Marriages sometimes *appear* to be wrecked by trivialities—disagreement as to whether bridge is more important than a basketball game, failure to agree on who shall keep the household books, different views on credit buying, differences regarding pets. Usually, however, these disputes are symptomatic of a more basic difficulty—the failure of the two partners to develop a cooperative attitude. The particular incident cited as the cause of the final break is merely “the straw that broke the camel's back.” Marriage is a give-

and-take arrangement in which each participant must be willing to do part of the giving.

Various studies have shown that marriage in our culture is happiest when the partnership is a democratic one, with husband and wife playing approximately equal roles. When the wife is definitely dominant, trouble is almost inevitable in the spheres of social and sexual adjustment. To a lesser extent this is also true when the husband is extremely dominant (Maslow, 1942; Lu, 1952). It is apparently important too, that the partners agree as to whether equality should or should not prevail.

When randomly selected married and divorced couples were given a scale measuring their attitudes on the question of whether the husband should dominate or the woman should share equally in decisions, divorced couples differed significantly more in their attitudes than did married couples. Divorced women showed the strongest belief in equality of wives and divorced men believed most in male dominance (Jacobson, 1952).

Culture can be a strong factor in determining marriage-role attitudes, as shown in a study comparing attitudes of college students in Japan with those of college students in Japanese-American and Caucasian-American groups. The research instrument was a scale measuring male-dominant vs. egalitarian attitudes toward marriage. No difference was found between the attitudes of male and female Caucasians, but in the Japanese and Japanese-American groups the males tended to be male-dominant and the females egalitarian in attitude (Arkoff, Meredith, and Iwahara, 1964).

Research has shown that marital compatibility is accompanied by belief on the part of both the husband and the wife that the other is somewhat superior. Each party to a successful marriage tends to assume an attitude of humility in relation to the partner. This factor is more important for wives than for husbands. The wife in a successful marriage tends to look to the husband for leadership more often than the husband looks to the wife (Kelly, 1941).

Intimate, free-flowing communication is another important factor in marital happiness. Couples who usually communicate effectively and without restraint tend to be better adjusted than those who cannot do so.

Scores of 126 couples on a marital adjustment test were correlated with scores on a test of "primary communication." The latter included items on whether or not the couple could communicate through glances or gestures, whether they used words which had a special meaning for themselves not understood by outsiders, whether they could discuss their most sacred beliefs without embarrassment, whether they would rather talk about intimate matters with each other than with outsiders, and similar questions.

There was a significant positive correlation between primary communication and marital adjustment. Younger couples engaged in a greater amount of primary communication than did older couples, and husbands with more education had greater primary communication than did those with less (Locke, Sabagh, and Thomes, 1956).

CHAPTER SUMMARY

Emotion is undeniably conscious experience. The emotions may be arranged along a dimension of pleasantness-unpleasantness called the *affective scale*. Another major aspect of emotion is the role it plays as an *energizer*. In emergencies, emotion makes possible action over a longer period of time than otherwise, enables the individual to exert maximum strength momentarily, and renders him less sensitive to pain. Emotions are like drives and motives in their ability to arouse, sustain, and direct behavior but typically occur in emergency situations and are dependent on cognitive evaluation of an external situation.

Some indication of the emotions of others may be derived from facial expression and from the voice. Individuals tend to agree upon the graphic representation of emotionally toned adjectives. One's own emotion and expression or repression of it affect one's perception of emotion in others. Patterns of overt emotional behavior include *destruction*, typical of anger; *approach*, typical of the pleasant emotions; *retreat*, typical of fear; and *stopping of response*, typical of gloom or grief.

The most sensitive and objective method of studying emotion is measurement of the physiological changes which take place. The accelerated activity of the *adrenal medulla* during emotion is responsible for many of the visceral changes which occur. Changes in the *galvanic skin response* (GSR), together with certain other physiological changes, are measured by the lie detector. *Pupillometrics* is a new method of measuring physiological changes during emotion, based on the fact that the pupil of the eye dilates in response to stimuli which arouse favorable emotions and contracts in response to distasteful stimuli. Few modern psychologists would go so far as to agree with the *James-Lange theory* that physiological changes are the emotion. Physiological arousal is an essential factor in emotion but it is guided by cognitive factors.

All of the internal and many of the external signs of emotion are commanded by the *autonomic nervous system* and carried out by smooth muscle tissues of the viscera, by the heart muscle, and by the glands. The autonomic nervous system is controlled by centers in the hindbrain and has synapses outside the central nervous system. It is composed of the *sympathetic* and *parasympathetic* divisions, which operate antagonistically. The sympathetic is largely a distributing system, while the parasympathetic governs most of the vital functions of life. However, the sympathetic takes over in emergencies, notably during extreme cold, violent effort or exercise, and fear or rage.

Changes in the pattern of *brain potentials* during emotion indicate that the cortex plays a role in emotional behavior. Cortical functioning affects emotional responses by relating current happenings to past experience, executing emotional responses by arousing visceral activity to some extent, and serving as a check on unrestrained response. The *prefrontal areas* are particularly active in the inhibition of certain kinds of emotion and the expression of others, while the *transitional cortex* plays a major role in producing visceral responses and vocalizations.

Subcortical centers which are important in emotion are found in the *thalamus*, the *subthalamus*, the *hypothalamus*, and the *rhinencephalon*. For each primary drive, there is an inhibitory and an arousal center. Centers in the

subthalamus and hypothalamus are capable of executing primitive emotions of rage, fear, and sex. The hypothalamus also contains the *ventromedial nucleus*, which restrains emotion, as does the *septal region* of the rhinencephalon. The *amygdala*, located in the temporal lobe, acts as an accelerator of rage and sex; its removal produces extreme tameness. The *pyriform cortex*, located just below the amygdala, inhibits sexual behavior; damage to it can cause hypersexuality.

Conditioning experiments indicate that animals probably feel emotion. When the *reward centers* of the brain are electrically stimulated as the animal presses a bar, he will press it rapidly and repeatedly though he receives no other reward.

Psychosomatic medicine is concerned with the treatment of ailments which result at least partially from sustained emotional arousal and which may involve tissue damage as well as unpleasant symptoms. Some studies appear to indicate that psychosomatic reactions are learned. Other studies show that in many cases the onset of a serious illness such as cancer occurs within about two years after a cluster of life changes called a *life crisis*.

A concept which is useful in understanding psychosomatic disorders, developed by Selye, is that of the *general-adaptation-syndrome*. According to this theory, the body reacts to stress in three major phases: (1) the *alarm reaction*, during which physiological symptoms appear in response to the application of a stress-provoking agent or *stressor*; (2) the *stage of resistance*, during which increased activity of the *adrenal cortex* and the *anterior pituitary* help the organism adjust to stress and cause the original symptoms to disappear; and (3) the *stage of exhaustion*, which occurs when the organism can no longer maintain its resistance to stress. Increased resistance to one stressor is commonly accompanied by lowered resistance to other stressors.

Both maturation and learning play a part in the development of our complex emotional behavior. Early experiments by Watson, who believed fear, rage, and love were inborn emotions, showed that many emotions which had

formerly been considered instinctive were really the result of conditioning. Watson also demonstrated the spread of conditioned emotional responses to similar objects through *stimulus generalization*.

More recent investigators have modified and extended Watson's work by pointing out the importance of such factors as the nature of the stimulus, individual differences in emotional response, and the role of maturation in emotional development, particularly in the differentiation of emotions during infancy. With maturation also comes the ability to interpret various factors in the environment as threatening or rewarding and to react to symbols.

In general, emotional development from infancy through emotional maturity is characterized by an increasing variety and richness of emotional experience and by improved ability to control the emotions by expressing them in socially approved ways. *Moods*, longer lasting and less intense than emotions, vary with the day of the week and the hour of the day as well as with the seasons. In old age, emotional responses are typically less intense and more rigid.

A fundamental facet of emotional maturity for most people is *adjustment in marriage*. Marital success depends on being (or *becoming*) the right person, as well as on *finding* the right person. Studies of the factors involved in marital happiness show that similarity in amount of education, complementary personalities, shared family interests, and economic security all favor happy marriages. Hasty marriage, emotional immaturity, and money troubles frequently lead to marital failure, but differences in age and in religion do not seem to be major factors. Presence or absence of children is less important than similarity of desire for children. It is not even essential that couples understand each other's personalities in order to be happy. However, in our culture at least, it is important that the partnership be a democratic one, with husband and wife about equal in dominance, and each believing that the other is somewhat superior. Intimate, free-flowing communication is also an important factor in marital happiness.

Chapter 13

Outline

KINDS OF FRUSTRATION

ENVIRONMENTAL FRUSTRATIONS
PERSONAL FRUSTRATION
CONFLICT FRUSTRATION

THE DYNAMICS OF FRUSTRATION

THE MOTIVATIONAL NATURE OF FRUSTRATION
EGO-INVOLVEMENT

DEFENSIVE REACTIONS TO FRUSTRATION

AGGRESSIVE REACTIONS
WITHDRAWAL REACTIONS
COMPROMISE REACTIONS

NEUROTIC REACTIONS

ANXIETY REACTIONS
PHOBIC REACTIONS
OBSSIVE-COMPULSIVE REACTIONS
DISSOCIATIVE REACTIONS
CONVERSION REACTION
ASTHENIC REACTION
DEPRESSIVE REACTION

PSYCHOTIC REACTIONS

CHARACTERISTICS OF THE FUNCTIONAL PSYCHOSES
ORIGINS OF PSYCHOTIC BEHAVIOR
EXPERIMENTAL STUDY OF PSYCHOTIC BEHAVIOR

ALCOHOL, DRUGS, AND GAMBLING

ALCOHOLISM
DRUG ADDICTION
COMPULSIVE GAMBLING

Chapter 13 Reactions to Frustration

Preceding chapters have shown how human beings constantly strive toward goals which gratify their biological and psychological needs. Sometimes people reach their goals with relative ease. But what happens when their needs are frustrated over a long period of time—that is, when they are prevented from reaching their goals?

Human adjustment is a never ending process of dealing with frustration. Serious frustrations of our biological drives have become relatively rare in the United States with its high level of prosperity and its ample welfare programs, but frustrations of our psychological and social needs have become even more common than they were in earlier times. Today we face business competition, marital problems, social laws and taboos, international tensions, and many other frustrations that are difficult to attack directly. And in our daily living we face one minor frustration after another—broken dates, late trains, blown fuses, fallen cakes, power failures, lost papers, absent friends, and so on and on.

How can we adjust to these constant frustrations? Sometimes we can overcome them, but sometimes we must yield to them, and often we must learn to live with them year in and year out.

frustrations may be classified into three main categories: *environmental*, *personal*, and *conflict*.

Environmental Frustrations

Our environment is full of obstacles that impede our progress. Our physical environment may frustrate us drastically at times through earthquakes, tornados, famines, or floods. It also provides innumerable petty frustrations—the barking dog that keeps us awake at night, the traffic jam, the uneven sidewalk that makes us stumble, the pen that will not write, or the rain at the ball game.

More serious, generally, are the obstacles provided by our social environment. Formal laws and social conventions prevent us from freely expressing many of our impulses. The man who has to work with unpleasant associates, the orphan cared for in the impersonal atmosphere of an institution, and the member of a minority group in a prejudiced community all suffer social frustrations.

Personal Frustration

An individual suffers personal frustration when he is prevented from realizing his ambitions by some personal limitation—either real or imagined. A boy who wants to play on the school basketball team may be thwarted by his lack of height. An individual who wants to go to a particular college may be thwarted by his inability to pass the entrance examination. Both physical and psychological barriers may be sources of personal frustration. For example, a boy may be shy because he feels that he is phys-

KINDS OF FRUSTRATION

The endless array of situations that block modern man's complex motives and produce

ically unattractive or because he feels that he lacks social skills.

Personal frustration frequently builds up *feelings of inferiority* and a felt lack of personal worth which, in turn, serve to increase the frustration. A questionnaire administered to a large group of college students showed that fewer than 10 per cent of the respondents had never experienced inferiority feelings about some aspect of their personal capacities—physical, social, intellectual, or moral (Allport, 1937). But college students as a group actually tend to be *superior* in all of these categories. Why, then, did they see themselves as inferior?

The answer to this paradox lies in the fact that feelings of inferiority are based not on actual inferiority but rather on one's *level of aspiration*. College students feel the need to compare themselves not to the population in general—to whom they are clearly superior—but to other college students (Festinger, 1954). If an individual's level of success in some activity falls below the level of the goal he has set for himself, he feels frustrated. Goals should be a challenge, but unrealistic expectations only invite failure and a feeling of inferiority.

Conflict Frustration

When an individual must choose one or the other of two goals or has both positive and negative feelings about a particular goal, he faces *conflict frustration*. Since motives may be either positive or negative—either seeking or avoiding—there are four possible types of conflict: *approach-approach*, *avoidance-avoidance*, *approach-avoidance*, and *double approach-avoidance*.

Approach-approach conflict. When the individual has two desirable but mutually exclusive goals, his situation is described as an *approach-approach conflict*. For example, a child holding a valued toy may see a kitten he wants to pet. In order to take up the kitten, he must put down the toy. At the adult level, a young man may want to marry and also to finish his education but, for financial reasons, not be able to do both. Conflicts of this type must usually be resolved by choosing one goal over the other, ei-

ther excluding one entirely or deciding which to do first.

Avoidance-avoidance conflict. When the individual seeks to avoid two unpleasant alternatives but cannot directly avoid one without encountering the other, he is confronted with an *avoidance-avoidance conflict*. For example, a student may not want to do all the studying a course requires, but neither does he want to fail the course. Or he may want to avoid working with some person on a committee but not wish to offend him by saying so. Conflicts of this type are most often resolved by "leaving the field." In the first example, the individual might drop the course. In the second, he might resign from the committee and volunteer for a different activity.

Approach-avoidance conflict. In an *approach-avoidance conflict*, the individual is attracted to an object or state of affairs and simultaneously repelled by something associated with it. For example, a child may want to pick a water lily in a pond but be afraid to wade out to get it. Or a person may want to safeguard his health by going to the doctor for a physical checkup but fear the possible consequences of such a visit. The closer the individual gets to the goal, the more strongly he is repelled by the negative aspects associated with it. Approach-avoidance conflict usually produces indecision and vacillating behavior.

Double approach-avoidance. A more complex kind of conflict is *double approach-avoidance*, in which both courses of action have good and bad features which must be weighed in order for a choice to be made. For example, a salesman may have to decide between two jobs—one with a rather small territory in a pleasant climate but with lower pay and the other requiring more travel in a colder climate but allowing him to handle a product he especially enjoys selling. The resolution of this type of conflict involves the type of decision making described in Chapter 10.

There are both successful and unsuccessful ways of adjusting to any type of frustration. In the following sections we shall examine some of the most common reaction patterns.

When any goal-directed activity is blocked, the normal individual experiences a psychological and physiological reaction which continues as long as the need remains unsatisfied. The physiological response to frustration is one of the many conditions which Hans Selye (p. 440) has called *stress* (Selye, 1956). Even though the "good sport" may meet defeat with a smile, his loss represents some degree of frustration and, therefore, of stress. As we have seen, severe and prolonged stress can lead to a variety of ills, from ulcers to heart trouble.

The Motivational Nature of Frustration

Frustration and the resultant stress add to the original drive, leading the individual to intensify his efforts to find a means of satisfying the initial, thwarted need. Thus the resolution of conflict and the consequent reduction of frustration are extremely important in motivating human behavior.

Sometimes, of course, an attempt to overcome a frustrating obstacle may be impractical. The best course of action then may be to leave the frustrating circumstances and find a situation where satisfactory adjustment is possible. For example, a student who is failing in his physics major because of a poor aptitude for mathematics might well change his major. The frustration of giving up a goal is often less than that of repeated failure. Usually, however, good

mental health requires resolving frustration by some means other than withdrawing.

Ego-Involvement

Many of our everyday frustrations function only as sources of minor annoyance. Some types of frustration, however, constitute real threats to our fundamental needs. For the mature adult losing his job, for instance, can be a source of genuine apprehension: the prospect of unemployment not only means reduced financial ability to satisfy his biological needs but also may involve feelings of insecurity, lowered self-esteem, and loss of social approval. The fear of flunking out of college or of failing in a required course can affect the college student in a similar fashion. Any such frustration, embodying as it does a threat to the individual's self concept, is said to be *ego-involving*.

Ego-involving frustrations are highly painful and call for an immediate defense. Just as we try to ward off a physical blow, so we tend to respond defensively to criticism or ridicule. The complex and varied behavior devices, or *mechanisms*, that we sometimes employ in self-defense will be discussed in the following pages. Since successful adjustment depends on how we *handle* our frustrations rather than on how many we have, it is extremely important for us to examine our own reactions as honestly as we can. Only in this way can we recognize and modify the ineffective ones.

As a normal human being goes through life, he builds up an extensive repertoire of psychological defense mechanisms which he uses—unconsciously—to adjust to ego-involving frustra-

tions. If moderate, such defensive behavior is normal, but when an individual is overly dependent upon such mechanisms, they may actually hinder rather than help his adjustment.

Even the most common defense mechanisms are complex and extremely varied. Depending on their general patterns, they can be roughly classified in terms of three fundamental types of adjustive behavior: (1) aggressive reactions, (2) flight or withdrawal reactions, and (3) compromise or substitute reactions. There are no hard and fast lines between these categories, and sometimes a mechanism has elements of two or even all three patterns. All of them involve a cognitive process of distortion—a perception of reality as other than it is.

Aggressive Reactions

As we saw in Chapter 11, aggressive reactions may be learned simply through imitation of others. However, much aggressive behavior is a reaction to frustration. When this is the case, the individual may attack either the obstacle blocking him or some substitute for that obstacle. Since attack is aimed at overcoming the barriers causing the frustration, aggressiveness would be highly adaptive were it not for the fact that modern man's very existence depends upon his living in social groups in which aggressiveness is carefully curbed. In particular situations, of course, aggression may be a realistic and acceptable mode of adjustment, as when a man shoots an armed burglar who has entered his home. Usually, however, aggression is not a satisfactory technique of adjustment. It may temporarily reduce the mental or physical tensions which accompany frustration, but in the long run it is likely to meet with social disapproval, punishment, or strong feelings of guilt. This, in turn, creates a new source of frustration.

Displaced aggression. Often an individual directs his hostile feelings toward some object or person other than the one actually causing his frustration. * This transfer of hostility is called displacement. The reasons for displacing aggression are several. The person may be afraid to express his hostility directly toward the one responsible for his frustration, in which case he is likely to find relief by "taking it out" on some innocent but less threatening person. Thus the office clerk who has been refused a raise may go

home and snap irritably at his wife and children. Or he may turn his hostility inward and blame himself for his failure. In still other cases the real course of the frustration is so intangible that it defies direct attack. Then the individual is all but forced to find some substitute object for his aggression. The most frequent forms of displaced aggression are *scapegoating*, "*free-floating*" anger, and attempted or threatened suicide.

Scapegoating. The clerk who snaps at his wife and children because he has failed to get a raise is using his family as a scapegoat. He turns on them the aggression he cannot direct toward his boss.

Displaced aggression is sometimes involved in such social phenomena as racial and religious prejudice. The relationship between frustration and prejudice is clearly revealed by statistics showing that such scapegoating is more prevalent during periods of economic depression, when many human needs are unsatisfied (Hovland and Sears, 1940; Mintz, 1946).

"Free-floating" anger. Sometimes a person develops a chronic reaction pattern of anger. His hostility, rather than being displaced onto a particular scapegoat, becomes generalized or "free floating," so that he tends to regard even neutral situations in a hostile way (Thorne, 1953). Even when it has some justification, the intensity of his anger is out of proportion to the situation. Chronic free-floating anger, often dating back to childhood hostility against the parents, may be expressed in hostility to practically all of a person's acquaintances, making normal friendship impossible. Occasionally, severe and prolonged frustration leads to a spell of blind rage, in which a person goes "berserk" and may even kill anyone who happens to be near.

Suicide. Sometimes when an individual is afraid to express his hostility openly, he turns it inward upon himself. Active aggression is displaced by self-accusation, which eventually can lead to attempted suicide or, more commonly, to threats of suicide (Shneidman and Farberow, 1956). A person who is contemplating suicide often seems less disturbed outwardly—even though his aggressive feelings may actually be greater—than someone who vigorously attacks his environment.

This generalization was borne out in a study of the personality patterns of mental patients who had threatened or attempted suicide. All of them showed greater hostility than did a control group, but those who actually attempted suicide tended to direct their hostility inward and to be deeply concerned with thoughts of death. In contrast to the resigned depression of these patients, those who threatened but did not attempt suicide displayed active outbursts of aggression and agitated depression (Farberow, 1950).

Displacement of aggression to the self is clearly revealed in the following case.

The patient was a hard-working man who had engaged in numerous occupations such as truck driving and farming after leaving school in the sixth grade. After he was admitted to the hospital, his behavior was characterized by excessive worry, irritability, outbursts of temper, and crying spells. He talked of suicide, saying that he was "no good anyway." He had always been very sensitive to his environment, being easily offended and taking disappointments extremely hard. Shortly before he entered the hospi-

tal, his symptoms had been aggravated by a crop failure.

In the hospital, the patient expressed his feeling that he was a failure, blaming his frustrations upon personal inadequacy. "I'm blue and all worn out all the time. I have spells when I feel like I could fly into a thousand pieces. I can't make up my mind what to do. I let my wife boss me all the time. The easiest way would be to have a train wreck. I'm a whipped man. I've worked hard all my life, and now I haven't anything." (Hathaway and Meehl, 1951)

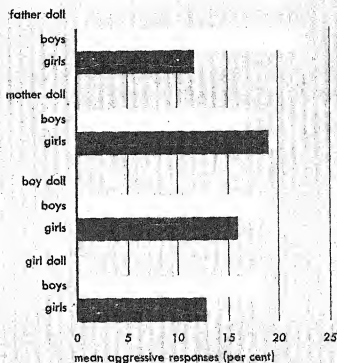
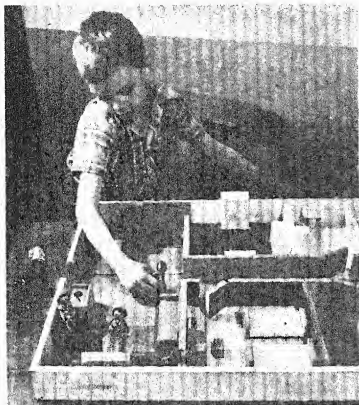
Obviously, this patient's self-esteem was very low. Although he felt some hostility against the world for giving him a hard battle, most of his aggressive feelings had been turned into powerful hatred of himself.

Patterns of suicide vary from country to country, depending upon cultural differences among them. For example, the rate of suicide in Sweden is high as compared with other European countries. Psychoanalysts explain this on the basis of early separation of the Swedish child from the mother, stimulating anger and



Displaced aggression ranges anywhere between a harmless venting of anger on some inanimate object (left) and the tragic scapegoating that history has sometimes recorded in the persecution of helpless minority groups who were blamed for all the dominant group's ills. This old woodcut depicts the custom of stoning Jews in Lent (right).

● A typical doll play situation is shown here (left). In one intensive study of children's aggressive responses in doll play, a comparison was made of aggressive responses of boys and girls toward dolls identified as various family members (right). In general, the boys showed more aggressive responses, with the greatest difference appearing in their responses to the father doll. Only toward the mother doll did the girls show more aggressive responses than the boys.



Based on Sears, 1951

lowering self-esteem. The Swedish male finds an outlet for his aggression in competitive sport and business, but because of the high standards he sets for himself he is highly vulnerable to suicide if he feels he is a failure. The Swedish female may resort to suicide if she fails to restore her damaged self-esteem by having a successful relationship with a man (Hendin, 1962).

The popular notion that suicides commit their act of self-destruction on impulse and without warning is not based on fact (Shneidman, 1965). About 85 per cent of suicides give a warning in advance by word or act which can be read quite clearly. It has often been said that people who threaten suicide never commit it, but this is not true. One of the clearest danger signals is some statement such as: "I want to die," or "I can't stand it any longer." The "trial run" or unsuccessful attempt at suicide is perhaps the clearest sign of all. Both word and act are "cries for help" and should not be ignored.

Controlling aggressiveness. For the protection both of individuals and of society as a whole, aggressiveness must somehow be controlled. There is danger not only in direct aggressions (like murder and assault) and symbolic aggressions (like libel and slander) but also in such noncriminal forms of aggression as overstrict child discipline, nagging, and violent displays of temper. Every day in psychological clinics, aggressive impulses are found to be at the root of many human difficulties in parent-child, husband-wife, and subordinate-superior relationships. In our culture we usually handle an aggressive individual either by punishing him for overt aggression or by allowing him to express his hostility in some controlled manner which does not violate the rights of other people.

Punishment. Perhaps the most familiar way of dealing with hostility is to quash it by placing taboos on aggressive behavior and making reprisals when the taboos are violated. This is

the method of control used in law enforcement and in strict child discipline.

The threat of punishment can be an effective device for controlling some expressions of aggressiveness; stealing, for example, might be even more prevalent in our society if it were not for the fear of being caught and punished. Yet, when a threat of punishment is actually carried out, it is likely to increase aggressiveness rather than reduce it, especially if the punishment is severe, for punishment itself is usually frustrating.

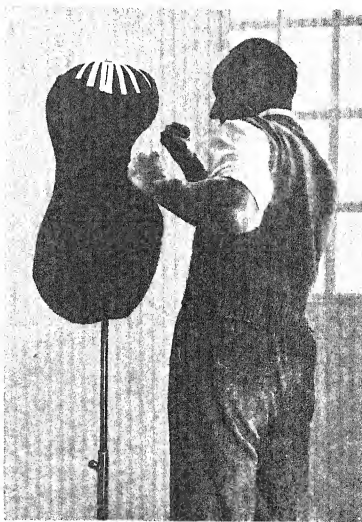
It is not always true, of course, that meeting aggression with threats and punishment will cause the person to become overtly more aggressive. Severely restrictive training, such as that experienced by the child of extremely domineering parents, can produce an outwardly fearful person. But even though such a person may learn to repress his hostility, it will probably continue to exist as an unconscious emotional undercurrent. This fact has been made especially clear in clinical work with severely inhibited children, who often display startling aggressiveness during treatment. For example, in doll play, a therapeutic technique to be discussed in Chapter 14, such children may actually destroy dolls which they have identified as the "mother" or the "father." Repressed hostility of this nature can have serious effects on the personality and behavior of the child.

Controlled expression. Society has become increasingly aware of the limitations of punishment as a method of preventing aggressive behavior. As a result, greater use has been made of the method of controlled expression, which gives the individual an opportunity to discharge his hostile emotional tensions into socially acceptable and even constructive channels. The basic principle of this method is to give aggressiveness relatively free but harmless expression by allowing the individual a time and place to work off his stressful feelings—either verbally or in vigorous work or play. Controlled expression has proved a valuable kind of therapy for dealing with excessive hostility in children and adults; one technique is described below.

A mental hospital in Rotterdam has reported that nearly all aggression among the patients has disappeared since the installation of a dummy for patients

to punch. The dummy is on a spring and always comes back for more, "demonstrating the senselessness of aggression." Since it is rather vague in shape, patients may regard it as the trunk or head of a person or even as some kind of animal, and they may draw with chalk on its bluish-black surface to heighten the illusion (Tolsma, 1953).

Even people with relatively few aggressive feelings can benefit greatly from learning how to give them controlled expression. Sports, crafts, hobbies, and household chores are excellent sources of relief from the tensions created by pent-up anger. The hard-playing child who is active in school groups, Scouting, YMCA programs, or other youth activities is much less likely to display aggressive or delinquent behavior.



Mental patients can work off aggressive feelings by attacking this punching bag. Because it is vague in shape and can be drawn on with chalk, it can be made to represent the object of the patient's hostility.

ior than the child who does not have such opportunities for releasing his tensions.

Many people give vent to their aggressions by reading of violence. There is even some evidence that the authors of such material also get release through their writing.

In one recent study, violent acts described in mystery fiction were rated on a scale from 1 to 100, with spitting in the eye, for example, rated at 17 and multiple shots with intent to kill at 64. Standard psychological tests were used to determine aggressive tendencies of the writers. Those authors who showed least aggression in their personal lives wrote the most consistently and intensely violent books, apparently using their pens to express pent-up aggressive feelings. The writers who were less meek in their day-to-day contacts showed greater variability in the degree of violence expressed in their books. Books written in the first person tended to express more intense violence than those written in the third person. All writers tended to describe more violent scenes when under personal or financial stress (Howard, 1957).

Controlled expression of aggression is sometimes looked upon as a kind of immunizing procedure. It seems possible that in experiencing small amounts of frustration and learning to deal with them satisfactorily, the individual may build up a capacity to withstand greater amounts—in much the same way that a person builds up immunity to certain diseases by experiencing mild cases of them through vaccination (Rosenzweig, 1938).

Withdrawal Reactions

A second basic type of defensive reaction is withdrawal from the frustrating situation. Basically a fear reaction, withdrawal may take the obvious form of physical flight or, more commonly, the subtler form of retreating within a "shell" of psychological defenses. Some of the more common withdrawal reactions are: *repression*, *fantasy*, *nomadism*, *"beatnik" reaction*, and *regression*.

Repression. A particularly important mechanism for meeting many of our daily frustrations is *repression*. Repression is the process of ex-

cluding from consciousness a thought or feeling that causes pain, shame, or guilt. Everyone has had the experience of suddenly realizing, after it is too late, that he has "forgotten" to perform some unpleasant duty. It is common, too, to repress the memory of an embarrassing incident. When there is excessive psychological pain associated with a particular experience, the individual's conscious memory of the event may be blocked entirely for a period of time.

It is important to note that *repression is not forgetting*. Although repression and forgetting are basically similar in that each is a process by which material formerly within consciousness is lost to voluntary recall, they differ in at least two basic and significant respects: (1) the cause of the loss of memory and (2) the completeness of the loss.

Many of our daily experiences are soon forgotten simply because they are of no use to us and thus are never reviewed. Repression, on the other hand, is selective, serving to protect the individual from the pain of certain thoughts and memories.

With ordinary forgetting, a person who cannot directly recall forgotten material can usually recognize it or relearn it more rapidly than he could learn new material. But repression is often so complete that the person can neither recognize nor relearn the material even when it is brought to his attention. That is, he actively (though unconsciously) keeps himself from responding to any stimulus which might cause him to "remember" certain painful things. However, when repressed material is brought back to consciousness—by hypnosis or some other technique—the recall is usually so complete that the person wonders how he ever could have "forgotten" it.

Sometimes there is a loss of memory immediately following an accident or other extremely unpleasant experience for which the individual feels he was to blame. This was true in a recent case of a helicopter accident investigated by the Civil Aeronautics Board by interrogation of the pilot under hypnosis.

Investigation showed that this particular crash had been caused by structural failure alone; however, the pilot thought it must have been his fault in some way and was unable to remember anything about the ac-

PERCENTAGE OF COLLEGE STUDENTS REPORTING VARIOUS TYPES OF DAYDREAMS

type	ever				recently			
	undergraduate		graduate		undergraduate		graduate	
	M	W	M	W	M	W	M	W
physical feat	91	60	96	58	30	3	13	2
physical attractiveness	89	95	94	96	34	63	17	56
mental feat	88	92	89	90	48	42	47	61
vocational success	100	98	99	93	81	69	78	64
money or possessions	100	97	94	95	69	66	51	52
display	78	76	90	83	22	16	19	19
saving	89	63	90	66	14	5	14	8
grandeur	67	48	63	39	11	7	6	0
homage	81	72	81	66	16	13	24	18
sexual	97	96	96	89	74	73	63	71
death or destruction	39	44	60	46	9	9	10	9
martyr	70	79	64	62	9	15	10	12
worry	92	89	87	91	45	56	49	50
other types	63	53	52	51	30	20	24	23
repeated daydreams	89	93	83	87	48	51	36	47
median number of types	13	12	13	11	5	5	4	5

cident. His amnesia was apparently a form of protection against feelings of guilt.

Under hypnosis he recalled every detail of events immediately preceding, during, and after the crash. He even remembered the make and (almost exactly) the license number of the car in which the passengers had arrived to board his helicopter. He recalled being projected outward through the plexiglass front of the helicopter as it shattered in front of him. Other relevant events, such as a sudden speed-up of the engine before the crash—the type of detail not usually recalled by survivors—also came to mind, as did his attempts to prevent fire after the crash. The technique of hypnosis can be of considerable value in investigations of this nature, since it brings to light information that can be used in preventing future accidents. If the subject is actually guilty of causing an accident and wishes to hide his guilt, however, he may continue to hide his true actions even under hypnosis (Mason, 1965).

Although repression occurs in some degree in nearly all normal adjustive behavior, it can be severely handicapping when excessive. For one thing, it often forces the individual to rely upon additional defense mechanisms so that he can avoid recognizing the real nature of his conflict and at the same time give indirect expression to his repressed feelings. More significantly, repression makes it impossible for him to develop

more realistic and adequate modes of adjustment. So long as the source of his difficulty is repressed, he can never deal with his problem effectively. A major goal of much psychotherapy is helping patients recognize and come to realistic terms with their repressed feelings.

Many psychologists differentiate between repression and *suppression*. The latter term describes a conscious effort on the part of the individual to forget by turning to other activities. Deliberate suppression may eventually lead to true forgetting.

Fantasy. When a person's desires are frustrated by reality, he may retreat into a fantasy world where his thwarted wishes can be satisfied. To create fantasies or daydreams as a temporary escape from the frustrations of reality is a perfectly normal activity, unless it is carried so far that the individual gives up striving for satisfaction in the real world. There is evidence that daydreaming is a nearly universal activity among normal young people of both sexes.

One study investigated the fantasies of 195 undergraduate and 195 graduate students. The ages of the students ranged from eighteen to fifty, with a median age of twenty-one for the undergraduates

and twenty-eight for the graduates. In both groups daydreaming was prevalent—in fact, only 3 per cent of the subjects reported having had no recent daydreams. Among the most frequent fantasies were those of vocational success, money or possessions, and sexual conquests (Shaffer and Shoben, 1956).

The frequency of daydreams is apparently determined by the strength of the underlying motives and the degree to which these motives are being frustrated. Young children daydream of food more often than teen-agers do, because food (especially candy) represents one of their greatest sources of satisfaction. Adolescents, in turn, frequently daydream about love, because they generally are experiencing considerable frustration of their new-found interest in sexual activity.

Satisfaction may come from night dreams as well as from daydreams—both express unsatisfied desires. Indeed, psychoanalysts maintain that the primary function of nearly all dreams is to fulfill wishes frustrated by reality. Sometimes the fulfillment of a wish is obvious from the surface content of the dream, but often it is accomplished through symbols that the dreamer himself cannot readily interpret.

Wish fulfillment is clearly illustrated in the following dream, reported by a college student who had been having the dream quite often. The setting of the dream was in a town in California where his parents owned a mine:

"I worked hard in our gold mine, but was getting stronger and wealthier every day. I hadn't shaved for three weeks and my only companion was my faithful Irish setter. I would go fishing and hunting every day. Once a month I would go into town for food and various other things. As all the other fellows would come into town about that time, we would have a big two-day celebration, and then hit back for the hill."

The student had spent every summer that he could remember in the mountains near the mine, hunting and fishing, except the summer preceding his dreams. Summer school kept him at home so that he had not gone on a single hunting trip or even gone fishing, and he had missed it very much. His frustration was partially overcome in his dream.

Nomadism. When someone continually wanders from place to place, always "on the move," even when moves bring no tangible gain, he is called a *nomad*. Nomadism is sometimes evidenced by repeated shifts of residence, divorces, or job changes. Hundreds of thousands of people, aimlessly seeking contentment, move about "just to be going."

Melvin Purvis, a former F.B.I. agent, has given a good word picture of nomadism in describing Volney Davis, a young gangster.

"Volney Davis had that maddening restlessness so common to the professional hoodlum. He could not stay still. Even when he was fond of a girl, he could not remain long in the same place. He explained that he 'had to get going.' Sometimes, he told me, he would climb into an automobile in the middle of the night and ride and ride with no particular destination or purpose in mind. His only object was to put miles between himself and the place he had been." (Purvis, 1936)

As an attempt to escape a frustrating situation, a nomadic reaction is seldom satisfactory, for frustration cannot be outrun.

"Beatnik" reaction. The eccentric behavior of the "beat generation" may be regarded as a withdrawal reaction from the frustrations of modern life. By his labored nonconformity, the "beatnik" stands apart from society and avoids most of his responsibilities as a citizen, without being obliged to stand for any particular set of ideas or to work for any particular cause. Special dress and slang, certain rituals, and sometimes the use of drugs are factors in making the member of the "beat" cult feel he is actively rebelling, when actually, according to one sociologist, he is merely expressing "apathy grown self-conscious" (Powell, 1960).

The maladjustment of beatniks has been confirmed in a recent study made by two psychiatrists.

For an entire year one of the psychiatrists, F. J. Rigney, spent most of his evenings in the "beat" colony of San Francisco attending parties, talking and listening to beatniks, and persuading them to take a series of four standard psychological tests administered by his assistant. A total of eighteen women and

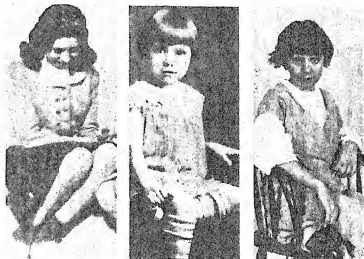
thirty-three men, about a third of the entire colony, were tested. Only fifteen of these fifty-one could be regarded as psychologically sound. The rest showed varying degrees of inability to cope with the problems of life. More than half were unable to hold a steady job, and more than one fourth were divorced. One sixth were alcoholic, and 4 per cent, as compared to about .2 per cent of the general population, were addicted to drugs. Furthermore, five were undergoing psychotherapy and seven had been in mental hospitals. In fact, there were so many overt symptoms of mental illness that "at some of the parties, the atmosphere was not unlike that in a hospital mental ward" (Rigney and Smith, 1961).

Regression. Sometimes a frustrated individual unconsciously seeks to return to an earlier, more secure period of his life. This is known as *regression*. In regressing, the individual flees from the painful realities and responsibilities of the present to the protected existence of his childhood. He reverts to old habits of adjustment—such as weeping, pouting, or emotional displays—which worked in the past but are scarcely adequate for solving adult problems.

"A seventeen-year-old girl was brought to a psychiatric clinic by her mother with the complaint that for the preceding five months her behavior had become increasingly destructive and irrational. The history revealed that after the patient was about four years old her parents had begun to quarrel violently, making her early environment extremely contentious and unstable. At about this age she first developed various neurotic traits: nail-biting, temper tantrums, enuresis [bed-wetting] and numerous phobias." She was excessively attached to her father, but when she was thirteen the parents were separated and the mother gained legal custody of the girl. The patient became resentful and quarrelsome, and began to engage in delinquent behavior.

Three years later, after a brief visit to the father had brought on a violent scene between the parents, "the patient refused to attend school and rapidly became sullen, withdrawn, and noncommunicative. During her mother's absence at work she would throw the house into disorder, destroy clothes her mother had made for her, and throw her mother's effects out of the window. During one of these forays she discovered a photograph of herself at the age of five, which, incidentally, was so poorly lighted and faded

● This seventeen-year-old girl is shown (left) as she looked before she found the photograph of herself taken when she was five (center). She then altered her appearance (right) to resemble the old photograph as much as possible.



that, for one detail, it did not show her eyebrows. Using this as a pattern, she shaved off her own eyebrows, cut her hair to the same baby bob, and began to affect the facial expression and sitting posture of the pictured child. ● When brought to the hospital her general behavior was correspondingly childish; she was untidy and enuretic, giggled incessantly or spoke in simple monosyllabic sentences, spent most of her time on the floor playing with blocks or paper dolls, and had to be fed, cleaned and supervised as though she were an infant. In effect, she appeared to have regressed to a relatively desirable period in life antedating disruptive jealousies and other conflicts; moreover, she acted out this regression in unconsciously determined but strikingly symbolic patterns of eliminating the mother as a rival and regaining the father she had lost in her childhood." (Masserman, 1946, p. 64)

Although such a severe case of regression is very rare, it shows the behavioral extremes to which unconscious defense mechanisms can occasionally lead. If the patient had received psychotherapy before her illness became so serious, she might have been helped to make a realistic adjustment to the frustrations in her life.

Usually regression appears in relatively mild forms, and it may not even interfere seriously with the individual's adaptive efficiency. One familiar form of mild regression is homesick-

ness: when a person has to face new problems in a new environment and finds adjustment difficult, he often falls back upon thoughts of home, where he could always find sympathetic understanding and help. Another familiar example is the "Old Grad" who never misses a homecoming game at his alma mater.

Regression can occur at any age. A common problem in households where a new baby has just arrived is that of the jealous three- or four-year-old child who reverts to baby talk, to bed-wetting, or to other outgrown habits in an effort to regain his parents' full attention.

Compromise Reactions

In many life situations frustration cannot be reduced by either aggressive or withdrawal reactions but only by some sort of compromise. You must partially give in to the threats that your frustrations imply, but without relinquishing entirely the goals they block. This generally means lowering your ambitions or accepting symbolic and substitute goals. For instance, a student who is refused admission to dental school may decide to become a dental technician. The compromises we make are often completely below the level of our consciousness, although their terminal effects are obvious to all. Some forms of compromise are healthy and just; others are not.

Sublimation and substitution. Direct satisfaction of a particular need is often impossible either because the goal is physically inaccessible or because the behavior involved in achieving the goal would be painful or guilt-provoking. In such cases the individual may resort to indirect means of obtaining gratification, choosing an alternate goal toward which to direct his energies. Although such goals never provide exactly the same satisfaction as original goals, they provide an outlet for the expression of frustrated desires and often afford real satisfactions of their own. Such indirect expression of a need may take the form of either sublimation or substitution.

In *sublimating* a need which he cannot satisfy directly, the individual accepts some alternate goal which provides a *socially acceptable*

outlet of expression and which provides partial satisfactions that are free of guilt feelings. Although the new goal is symbolic of the original one, it can be pursued openly without feelings of guilt. Hostility, for example, can be sublimated through participation in competitive sports, especially those which involve physical contact, such as football, boxing, and wrestling. The term *sublimation* usually refers more specifically, however, to indirect expressions of the sexual urge. Artistic activities are often interpreted as sublimations of this sort. Reading and writing romantic prose and verse are other socially approved sublimations of the sexual drive, even though their sexual element is often rather thinly disguised. According to some psychologists and psychiatrists, all forms of work—science and business as well as the fine arts—result from the sublimation of sexual energy. *Sexual* is used here in the Freudian sense, referring to all instinctive, pleasure-seeking impulses of the organism.

Frustrated impulses are sometimes expressed indirectly by the *substitution* of activities in which the conscious quality of the desire is not fundamentally changed. When sexual impulses are frustrated, for example, substitution may take the form of masturbation or undesirable verbal behavior—telling risqué stories, writing obscene poetry, singing smutty songs. Substitution is likely to involve activity that is less socially acceptable than sublimation, so that it is typically accompanied by some feelings of self-disapproval, guilt, and inferiority.

Reaction formation. When a person unconsciously represses his socially unacceptable desires because the very thought of them is guilt-provoking, he may develop conscious attitudes and overt behavior patterns that contradict his unconscious wishes. For example, if a person is troubled by sexual desires that he cannot accept as normal, these desires may be repressed to an unconscious level and be replaced in his consciousness by extremely puritanical attitudes. This mechanism, known as *reaction formation*, helps the individual guard himself against his unacceptable impulses.

Usually reaction formation is more than a mere counterbalancing mechanism, for the conscious attitudes which develop tend to be exag-

gerated, extreme, and intolerant. In suppressing his real feelings of hostility toward people, for instance, the individual may be "overnice" and irritatingly solicitous. Social crusaders and fanatics who vigorously campaign against minor vices and loose public morals are frequently battling their own unconscious desires. Within limits, reaction formation can be of real value in preventing behavior that is undesirable. But in the extreme, it, like other defense mechanisms, can result in behavior that is personally and socially harmful.

Projection. Sometimes when a person would find his true thoughts and feelings intolerable, he not only represses them but also convinces himself unconsciously that *other* people have these thoughts and feelings toward *him*. By this mechanism of projection the individual is able to direct his aggressive feelings toward others rather than toward himself. An example of projection is the unfaithful husband who accuses his wife of infidelity—actually believing her to be unfaithful in the face of what, to an impartial observer, would be overwhelming evidence to the contrary. Another example is the irritable or selfish person who sees everyone else as irritable or selfish while convinced that he is selflessness itself.

Projection also enables a person to blame other people—or even things—for failures that are essentially of his own making. After having a fight or disagreeable scene, it is easy to see the other person as wholly at fault: "He started it," or "He had it coming to him." The student who fails a course may claim that the instructor disliked him. And the golfer who drives his ball into the water hole may blame his misfortune on a "dead ball." By enabling a person to blame other people or things, projection helps to protect his feelings of self-esteem.

The Freudian explanation of projection is that the demands of the id cause great anxiety, which the ego attributes to some external cause, since it can cope with external dangers more easily than with internal ones. Other psychologists feel that the individual who is projecting is simply making a poor discrimination as a form of avoidance. By not discriminating that an error is due to his own carelessness rather than to that of others, he avoids the unpleasant

experience of facing up to his own inadequate performance.

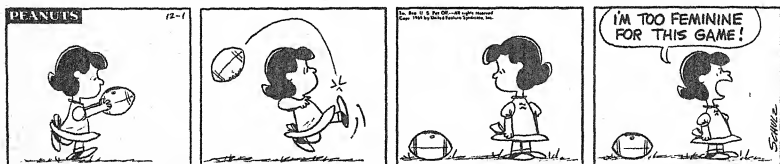
Compensation and overcompensation. The feelings of inferiority that typically accompany failure in some activity are often counterbalanced by the individual's entering some other sphere of activity in which he can succeed. That is, he "covers up" his felt weaknesses by withdrawing from situations in which they would be evident and turning instead to activities more likely to bring success and approval.

Compensation may be defined as an attempt to disguise the presence of a weak or undesirable trait by emphasizing a desirable one. A person who feels socially inadequate because of physical unattractiveness, for example, can compensate by developing a charming manner and learning to be an interesting conversationalist. Such a person is welcomed as a friend, and his physical unattractiveness is no longer a great obstacle to social success. Because compensatory behavior is aimed at bringing social approval to the individual, it sometimes results in accomplishments of considerable social value.

But compensatory activity, like any other defense mechanism, ceases to be of value to the individual when it gets out of control. Suppose, for example, that a physically unattractive child is ignored by his schoolmates and generally "left out of things." He may want so desperately to gain recognition that he will *overcompensate* by asserting himself in ways that further alienate his classmates—such as talking too loudly or "showing off." Often he develops such a deep sense of inferiority that ordinary acceptance is no longer sufficient to relieve it—to feel safe and secure he must keep trying to prove that he is *superior* to others. In the long run, overcompensation is seldom effective in reducing frustration, since the social disapproval incurred by such behavior only tends to increase the individual's sense of failure and inferiority.

Intellectualization. Another way to compromise with problems is to intellectualize them, thus partially divesting them of personal significance or painful feeling. There are three basic mechanisms of intellectualization: (1) ra-

◆ The purpose of rationalization is increased self-esteem: to keep from recognizing signs of our weakness or inadequacy for what they are, we reinterpret them as signs of admirable qualities.



tionalization, or excuse-making; (2) isolation, or the use of "logic-tight compartments"; and (3) undoing, or ritualistic "cleansing" behavior (White, 1964).

Rationalization. Rationalization is an unconscious process of devising seemingly logical explanations for a situation that would otherwise result in loss of social approval or self-esteem. ◆ It takes many forms. There is the "sour grapes" attitude, so well portrayed in the old fable of the fox who tried in vain to reach a bunch of grapes hanging over his head and then decided they were "too sour" anyway. There is the jilted lover who suddenly realizes that his former girl had certain flaws. There is the "sweet lemon" philosophy of J. M. Barrie: "Not in doing what you like, but in liking what you do is the secret of happiness." And there is the rationalization of the wrongdoer, who claims noble motivation to justify an act that is anything but noble. Al Capone, hoodlum and bootlegger, is reputed to have felt that he was being unfairly persecuted by police—that he was only trying to bring a little pleasure into people's lives.

Although rationalizations are "logical," they are generally based on false premises. Most everyday rationalizations are inconsequential, but if an individual relies too much on this defense mechanism, he may develop unrealistic ways of dealing with life.

Isolation. People often avoid conflict between two opposing desires or attitudes by keeping them apart in consciousness. Certain ideas are sealed off in mental compartments, as it were, and allowed to function in isolation

from conflicting ones. Thus the person never has to choose between them. Such mental compartments are said to be "logic tight" because they enable the individual to maintain contradictory ideas or attitudes at the conscious level without recognizing that they are logically incompatible.

People with logic-tight compartments think and act inconsistently. The following statement illustrates this type of thinking: "All lawbreakers should be tarred and feathered by law-abiding people." Right-wing extremists who advocate the use of communist tactics to fight communism are good examples of people with logic-tight compartments.

Undoing. Undoing is a mechanism whereby an individual can divest himself of painful feelings by ritualistic "cleansing." This mechanism is well illustrated in the following case:

A seventeen-year-old boy had a severe conflict about masturbation. In a talk denouncing this practice, his pastor had advised that one should never associate with a boy who masturbated. The patient knew a boy who did so and found it very hard to keep away from him. Whenever he saw him, he felt uneasy. Soon he began turning around and spitting whenever he passed the forbidden boy (Fenichel, 1934).

This little ritual is an example of undoing. By means of it the patient expressed rejection and cleansed himself immediately after making the forbidden contact with the other boy.

Identification with the aggressor. Often the person who feels thwarted protects himself by

making an identification with the thwarter. By this mechanism the frustrated individual incorporates into his own personality structure the achievements or qualities of those who frustrate him. The saying, "If you can't beat 'em, join 'em," testifies to the frequency of this mechanism in our competitive society. Another example of this form of defense is the statement made by a little girl who was afraid of ghosts. Running in the dark, the child made peculiar gestures and later told her brother, "There is no need to be afraid; you just have to pretend that you're the ghost who might meet you." (Freud, 1937)

Obviously, identification with the aggressor is primarily a defense mechanism of the weak against the strong. Prisoners often attempt to reduce the threat to their existence by becoming "informers" or otherwise cultivating the favor of—and even incorporating the characteristics of—the guards whom they hate and fear. This type of identification was often seen among prisoners in German concentration

camps during World War II and among prisoners of the Chinese communists during the Korean War. It is often seen in the prison "trusty" who, although a prisoner himself, talks and acts as though he were a jailor.

A German psychologist who was imprisoned by the Nazis reports that a number of prisoners in the concentration camps accepted as their own the values and attitudes of the Gestapo in order to protect themselves from breaking down under the dreadful physical and psychological conditions. These people, taking over camp duties under Gestapo supervision, imitated guards in an effort to salvage their self-esteem and make themselves feel important (Bettelheim, 1943).

As has been pointed out (p. 462), the use of defense mechanisms is not in itself a sign of abnormality. Whether use of these mechanisms is healthy or unhealthy depends largely upon how much the individual relies on them and how well they actually reduce his frustrations.

NEUROTIC REACTIONS

The difference between a normal and an abnormal reaction is one of degree. As the psychologist thinks of it, "normality" includes a wide range of behavior rather than a single fixed point on a scale. In general, the normal personality operates as an organized whole and deals with frustrations more or less effectively.

The severity of the frustration an individual experiences depends as much on his interpretation of the situation, of course, as on the objective realities. The situation that a self-confident person can easily handle may seem overwhelming to a person convinced of his own inferiority. This explains why people often develop abnormal reactions when those around him can see little apparent cause in the external environment.

When frustration becomes too great, the individual's usual adjustive responses may be inadequate for dealing with it. His reactions may then become disorganized and exaggerated; instead of helping him cope with his problems, his attempts at defense may actually interfere with adjustment and thus heighten his frustration. Nevertheless, he tends to cling to his ineffectual behavior. He is inflexible and unwilling to change his responses. Thus he exhibits what has been called the "neurotic paradox" (Mowrer, 1948)—his behavior is self-perpetuating and at the same time self-defeating. Why does he continue to behave in a manner which only makes him even more unhappy? The observer often finds it hard to answer this question. Evidently the neurotic has a more

limited behavior repertoire than the normal person and finds it hard to develop an alternative behavior pattern. ▲ More important, however, is the fact that his behavior, unsatisfactory as it may be, nevertheless is reinforcing in that it temporarily lessens his anxiety. His neurotic symptoms enable him to escape something even more unpleasant.

The term *neurosis* is used to describe a wide range of ineffective defense reactions—from those that interfere very little with everyday living to some that are quite seriously incapacitating. The term *psychosis* is reserved for very severe mental disorders, usually characterized by a considerable loss of contact with reality.

All too often the term *neurotic* brings to mind a stereotyped image of a person who feels misunderstood or cheated by life, has queer ideas, or is very irritable and tense. Actually neurotics vary so much in their reactions that this, like most stereotypes, is very inaccurate.

In a revealing study, 100 college students and 11 professional workers were asked to respond to the items of a widely used personality inventory as though they were neurotic. The same test was also given to 176 patients who had actually been diagnosed as neurotic in clinics or hospitals. The results showed striking differences between the way neurotics really felt and the way college students thought they would feel. The largest single difference was shown on the item, "If people had not had it in for me I would have been much more successful." Whereas 36 per cent of the professional workers, 86 per cent of the female students, and 68 per cent of the male students who were pretending to be neurotic marked this item "True," none of the female patients and less than 4 per cent of the male patients marked it "True." A large percentage of the patients stated that they usually expected to succeed in the things they did, whereas not many of the dissemblers did. About 80 per cent of the dissemblers marked as "True" the item, "I have one or more bad habits which are so strong that there is no use in fighting against them," whereas fewer than 15 per cent of the patients did. On the whole, the normal individuals believed the neurotics had many more physical complaints, feelings of being misunderstood, sexual conflicts, bizarre ideas, and other abnormalities than they actually possessed, according to their own responses to the test (Gough, 1954).

This study indicates that it is unwise to make hasty generalizations about neurotics. In general, however, it is safe to say that they are relatively frustrated, disorganized, and unhappy individuals whose reaction patterns are inadequate for dealing with many life situations. Their symptoms are seldom so severe, however, that they require hospitalization. In the following pages a number of specific neurotic reactions will be discussed.

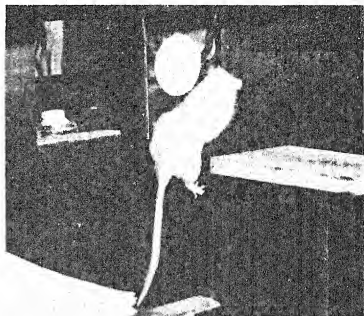
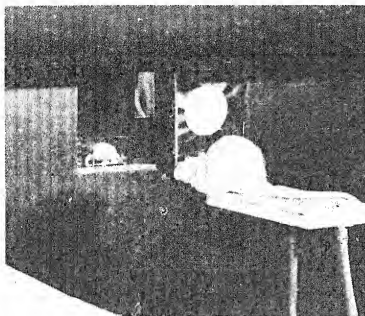
Anxiety Reactions

Neurosis has been explained in different ways by various personality theorists. Freud regarded it as an outgrowth of inner conflicts between the id and the ego. To Adler every neurosis arose from the fact that the individual's goal of superiority is always in conflict with painful experiences of inferiority (Adler, 1930). Those who regard self-actualization as man's supreme goal feel that neurosis is stimulated by anything that blocks self-actualization. According to the existentialists, the antidote to neurotic anxiety is success in bringing the actual self closer to the ideal self (Thorne, 1963).

Regardless of how their inner dynamics are described, neurotic disorders are based primarily upon *anxiety*—that is, generalized feelings of worry and apprehension growing out of unresolved frustrations. The tendency toward anxiety is often acquired early in childhood, when the child may be punished by parents and teachers for using socially disapproved methods in trying to satisfy such needs as the need for sexual gratification or the need for achievement and status. Having been punished for his way of expressing a particular impulse, the person may come to regard the impulse itself as dangerous and to feel anxious whenever he experiences it. Thus anxiety has much in common with ordinary fear, except that it is attached primarily to one's own impulses rather than to an external danger (Shoben, 1955).

When anxiety-provoking impulses arise, they are often repressed. This provides temporary relief, but it means that the individual is no longer aware of his true feelings or of the cause of his anxiety. His fear becomes "free floating"—he is anxious but does not know why. When

▲ Rigid, self-defeating responses similar to those seen in neurotic patients can be produced experimentally in rats and other animals. One way is to train an animal in a discrimination apparatus such as this; he has no difficulty learning to jump toward a pattern that regularly has food behind it, as long as the patterns are different enough for him to distinguish between. If the patterns are then made too similar, however, or if the same one is not consistently rewarded, the animal develops many of the symptoms characteristic of neurotics, including withdrawal, irrational excitement, and rigidity. The rat shown here, after extreme and continued frustration, has developed a rigid pattern of jumping only to the right. Even when the food is in plain sight (left), he jumps toward the obviously unrewarding pattern (right). By studying possible ways of overcoming such patterns in animals, investigators are learning more about how human beings with self-defeating, rigid patterns of behavior can be helped to overcome them and learn more adaptive, flexible ways of approaching their problems.



such anxiety constitutes the patient's principal complaint, his condition is called an *anxiety reaction*. He tends to experience feelings of impending doom and may have attacks of physical symptoms such as palpitation of the heart and great difficulty in breathing. He experiences intense guilt but does not know why. Here, in the patient's own words, is a description of a severe anxiety reaction:

'The first actual anxiety attack I experienced happened when I was nineteen years old. I was engaged to be married and to the best of my knowledge, there had been no particular reason for me to be distressed. One night after I was in bed just before copping off to sleep, I suddenly became obsessed with the idea of death, its finality and my utter helplessness in the face of it. As I remember, thoughts such as these kept running through my head: 'every

minute is one nearer death,' 'suppose it (death) means being shut off alone and helpless and never seeing any one again.' . . . finally, I became panic-stricken and I wakened my mother and told her my feelings. She reassured me somewhat by telling me that many people felt as I did from time to time and that I must relax and not let myself get too 'worked-up.' This helped me and I slept. The next few days I was troubled with the same thoughts and feelings from time to time. Then I told my fiancé, hoping for reassurance—he was not particularly understanding and told me it was foolish to think about such things since I couldn't help dying and it would not help to be afraid. I was terribly shaken by this for what I wanted was confidence and a feeling of being close to someone and his attitude only increased the very feelings I was struggling against. This situation continued off and on gradually diminishing and apparently I forgot all about it. During this first episode

there was no specific fear as fear is generally understood. It was more a feeling of horror, of finality and helplessness.

"About a year after this when I had been married about a month, I had quarreled with my husband over a rather minor matter and during the quarrel he suddenly turned on me and said he would commit suicide if I didn't stop. This frightened me and I stopped the argument at once. Later in the morning I was on a train going to my mother's (this had been planned before the quarrel). I was reading—the book happened to contain a rather bloody description of a murder—suddenly I felt faint and dizzy. I was alone in the car except for some laborers whom I felt could not assist me. I was panic-stricken. I thought I must be dying. I was afraid to call the conductor for fear he might not know what to do and frighten me more. Somehow I got to my mother's and told her the whole thing. She was very calm which helped me and the feeling passed off. In other words I was not afraid when I was with someone in whom I had confidence. I continued to lead a normal life for another month, fighting down the panic as best I could. It was hard, for the fears became concrete . . . fear of crowds and closed spaces, of loud noises and of being alone. . . .

"The final break came when I was to return home to my husband from a visit to my family. I was on the train accompanied by my mother. There was a tunnel along the line I had never been conscious of noticing before but this time I felt I must get off the train at once. I could not go through the tunnel! Why I didn't know. I felt dizzy, faint, choking—my clothes felt tight as though they would smother me; I could not get my breath. Again the idea of dying came out. I finally had to leave the train. . . . These episodes continued from time to time until I came under the care of a psychiatrist. . . ." (Strecker and Ebaugh, 1940)

In this case the patient's deep feelings of inferiority and insecurity could be traced to early childhood experiences. Although the patient was capable of running a home, her neurotic reactions made her very miserable.

Phobic Reactions

Frequently the free-floating fear of the anxious neurotic becomes attached to some object

in the environment, resulting in irrational fears. This process of displacing fear onto some environmental object is called a *phobic reaction*; it is similar to that by which repressed hostilities may be transferred to scapegoats. Phobic reactions may cause intense panic, as in the case of people who cannot bear to be closed up in a small room or to be on a high cliff or tall building. A person may have a number of such fears, or *phobias*, as in the following case.

" . . . She was afraid of men, afraid to be alone, afraid to be in any small room, afraid of thunder, afraid she was going crazy, afraid she had many diseases, etc.

"The more her case was discussed the more it became evident that she had fears in almost every field of human activity. She was working as a private secretary, but because of her intense anxieties, could hardly manage to keep her position. She wanted to 'run away from herself.' . . .

"A young man with whom she was going, and who had 'serious intentions,' would kiss her and 'hold her close'; the sexual thoughts aroused were to her unpardonable, sinful, and so intense that she stopped seeing the young man in an effort to get rid of these thoughts. However, the thoughts instead of ceasing, 'irradiated,' so that in the presence of any man she 'developed vague fears which sometimes produced a panic-like condition. The fears multiplied, and her 'entire life was one mass of anguish.' Her attitude toward life was that of fearfulness, . . . coloring all phases from the most intimate sexual desires to the most impersonal letters she transcribed in her work." (Kraines, 1941)

Occasionally a child develops what is known as *school phobia*, fearing and hating school to the point where he absolutely refuses to go. The real trouble in these cases is usually at home, but it is too painful for the child to express his fear and hostility there, so he uses the school as a convenient substitute (Suttenfield, 1954). In young children a school phobia may be caused by overprotection, by rejection, or by favoritism shown to a brother or sister. The same factors may operate in the case of adolescents, though here the school phobia is more often connected with the attitude of schoolmates or with the appearance of sexual urges.

Obsessive-Compulsive Reactions

Repressed desires and guilt feelings frequently lead to another type of abnormal behavior pattern known as an *obsessive-compulsive reaction*. Actually, obsessions and compulsions are separate types of reactions that may occur quite independently of each other, but they occur together so often that they are generally considered as two separate aspects of a single behavior pattern.

Obsessions. An obsession is a persistent and irrational thought that comes into consciousness inappropriately and cannot be banished voluntarily. Almost everyone has some sort of mild obsessional experience, such as the intrusion of petty worries: "Did I really lock the door?" or "Did I turn off the stove?" Having a tune "run through one's head" persistently is another common mild obsession. This latter phenomenon has been found frequently among persons under stress.

Seven employed adults and three college students, normally adjusted but struggling with such difficult problems (marital discord, vocational indecision, and so on) that they had consulted a psychologist, were asked to report any tunes they had noticed running through their heads. All reported that a tune had been bothering them, but only one reported more than one tune. This was a sixty-year-old school teacher with financial worries, who had suffered from a different tune on each of four days, all nonsensical songs that he did not like.

In contrast to this group of persons suffering from stress, a psychology class of 307 students reported on tunes which had stuck in their minds within the preceding two weeks. Only eleven reported the presence of recurring tunes, nearly all currently popular songs. All but one of them regarded the inner music as rather pleasant and had no desire to get rid of it (Berg, 1953).

Although such mild obsessions as persistent tunes can be quite irritating, true neurotic obsessions are much more insistent and so disturbing that they interfere with the individual's adjustive efficiency. Often they center about morbid thoughts of death or suicide or continuous fantasies of committing murder in some brutal fashion. Extreme obsessional reactions

can be almost completely disabling—the patient may be so overwhelmed by his recurrent obsession that he finds it almost impossible to concentrate on any other thoughts. Following is a description of an obsessive-compulsive reaction that was quite handicapping for a time, then cleared up temporarily, only to return under stress of military service.

Peter's mother was so timid and fearful that by the time he was eleven he had lost all respect for her. At about this time his father, who had been a traveling salesman, took a different job and was at home a great deal more. He took a great interest in his son's affairs and was extremely dictatorial. Although his father sometimes bought him expensive presents, they were usually things he did not want. The mother was terrified of the father, and upset by the fact that he was carrying on an affair with another woman. Thus Peter came to feel that he could expect considerable love from neither parent.

Peter turned to his grandfather, a scholarly man who was lonely because of the recent loss of his wife. He showered affection upon Peter and filled his mind with ideas about science and economic determinism which were difficult for an eleven-year-old to understand. Soon the boy became obsessed with the fear that his grandfather, his only source of affection, might die, as his grandmother had done. He thought of various ways in which this might happen and began to work out "magical acts" to prevent such a catastrophe. For example, if he thought of disaster while stepping on a crack, he had to step on the crack again to cancel the first thought. Then he began to step a few more times for good measure, until he was spending as much as an hour on such a sequence. When his odd behavior was noticed, he worked out elaborate rituals for cancelling all the unlucky thoughts of the day in his room at night.

When Peter was twelve his fears were realized—his grandfather did die. The boy was stricken with uncontrollable grief and cried for months. To make things even worse, the fatal illness was attributed by relatives to distress over Peter's father's love affair, indicating to Peter still another way in which his father had destroyed his happiness.

In his search for security and assurance, Peter worked out a vast scheme of universal laws based on some of the ideas his grandfather had discussed with him. With these to fall back on, he was able to overcome most of his compulsive ritual behavior and even

to participate to some extent in high school social life. Entering college, however, revived some of his early childhood fears. Worst of all, a course in philosophy cast doubt on his universal system. In an attempt to revise it and reconcile it with his new knowledge, he neglected his other work and "walked around in a daze all summer," as he expressed it.

The stress of military service was what finally led to a complete neurotic breakdown. Peter had suffered intense fear before entering the army, both fear of how he would be treated in training and also even more intense fear of being injured in combat or on the way to the combat zone. These anxieties steadily mounted after he was inducted, so that after only two months of training he was separated from the service and sought professional therapy for his neurosis (White, 1956).

A recent study suggests a link between obsessional disorders and previous neurological illness.

The histories of 103 patients with obsessional neuroses were compared with those of 105 patients suffering from nonobsessional neuroses. It was found that twenty of the obsessional patients (19.4 per cent), as compared to eight (7.6 per cent) of the others, had had previous neurological disorders of consequence (Grimshaw, 1964).

It is possible that the stress consequent to physical damage to the nervous system is relieved, in part at least, by obsessive thinking.

Compulsions. Because they are so insistent, obsessive *thoughts* commonly lead to compulsions—bizarre and incomprehensible *actions* which have no observable value. The individual himself does not understand them but nonetheless feels a compelling urge to express them. The severely obsessed patient may repeat to himself hundreds of times a day such strange statements as "The kiss of death is sweet" or "Sex is Satan." The person may sometimes carry out compulsive acts despite inevitable and serious injury to himself or others.

Compulsions are usually symbolic—that is, the patient resorts to the compulsive reaction as an indirect way of resolving some anxiety or repressed desire. Compulsions often take the form of "rituals" like those developed by young

Peter (above). These may involve detailed preoccupation with minor, everyday tasks. For example, guilt feelings may lead to frequent, compulsive hand-washing in a symbolic attempt to "wash away" the guilt.

A. B. was a successful businessman of forty-five who had a compulsion for "clean, healthy living." This desire was expressed in such wholesome activities as daily exercise, but it also had a secretive, ritualistic aspect. A. B. often took as many as fifteen baths a day, counting hasty sponge baths and alcohol rubs. He usually found an explanation, saying, "Got myself pretty sweaty today," or, "Messing around the warehouse. Grimy place. Dust and dirt of centuries." In taking a drink of water he furtively rinsed out his mouth. In his endless ritual before going to bed he made liberal use of alcohol and Listerine as well as soap and water. He carefully scrutinized the bed sheets, applying a few drops of Listerine to any place that "didn't look quite clean." He reported that he once worked vigorously for several minutes on a "spot" on the sheet, only to discover that it was a shadow cast by the edge of the bed-lamp. Fortunately A. B. realized that his behavior was illogical and fantastic and even showed a sense of humor about it, but he was unable to change it until its deeper causes were brought to light.

When A. B. was eight years old his older brother, whom he feared and disliked, discovered him in the act of masturbation. The brother made a disagreeable scene, calling A. B. "filthy," "dirty," etc., and threatening to expose him to the family. He made A. B. get down on his knees and swear never to do it again and promise to lead a "clean, healthy life." The brother terrorized A. B. repeatedly about the occurrence during the next two years. When his brother went away to college, A. B. managed to "forget" the experience. That is, he repressed it, but his anxiety later took the form of compulsion for cleanliness. He also became afraid of his little daughter and indeed was ill at ease with all children because he felt they could see through him. With the aid of psychiatric treatment, A. B. was able to overcome his compulsion and achieve happiness (Strecker, 1952).

Dissociative Reactions

Occasionally certain aspects of reality are so painful that the individual represses entire epi-

sodes of his life from consciousness. This type of extreme repression is called dissociation. Dissociative reaction may take several related forms, including *amnesia*, *fugue*, and *multiple personality*. These vary in the amount of repression involved.

Amnesia. Loss of memory—especially inability to recall past personal experiences—is termed *amnesia*. The amnesic individual is generally unable to remember his name and address, or other facts about his personal life. Amnesia may result either from organic causes (such as head injuries or diseases of the nervous system) or from purely psychological causes. If the loss of memory is the result of organic causes, it is usually permanent except in some cases of head injury; but if it is a result of repression, the “forgotten” material remains active at an unconscious level and can be elicited under hypnosis or, eventually, through psychotherapy. The following case shows an amnesic reaction to a frustrating and painful situation:

“A man married against his family’s wishes. He lost his job and was forced to appeal to his family for support. An uncle gave him some money, but warned him he would get no more unless he divorced his wife. On the way home the patient was held up and his money taken from him. He decided to jump into the river. But on his way to the river he forgot who he was and where he lived and that he was married; nor could he account for his being in that locality. He became perplexed and alarmed and asked a policeman for help. He was taken to a hospital and, one day later, recovered his memory of these incidents and his identity under hypnosis.” (Maslow and Mittelmann, 1951, p. 433)

The nature of the memory loss in psychological amnesia is selective. The patient, escaping from himself, may be unable to recall the simplest facts concerning his personal history yet be able to drive his car, read traffic signals, and take care of the simple necessities of life.

Fugue. Amnesia, a form of psychological flight, is sometimes accompanied by actual physical flight in which a person wanders off for days or even weeks and suddenly “wakes up” in some strange place, completely unaware of how he got there. Such episodes are called *fugues*

(from the Latin word meaning “to flee”). During the fugue the individual displays amnesia for his past life; after the fugue he regains normal memory of his past, except for his activities during the interlude. Under hypnosis, however, he may be able to piece together what has happened. The following is a typical case of fugue.

Bernice L., a thirty-seven-year-old housewife, disappeared from home without explanation or trace, and her whereabouts remained unknown to her husband or parents for the next four years. When she was discovered in a small town over a thousand miles away and returned to her home, she insistently denied her real identity and failed to recognize any of her family.

Under psychiatric treatment, her amnesia was gradually dispelled. After a dimly remembered and seemingly aimless journey she had finally reached the college town where she had spent the only happy period of her youth. She remembered nothing of her previous life, except that she thought her name was that of Rose P., a college roommate who had been very kind to her and had played an important role in her earlier life. Under this name she had begun to earn a living at the piano and within two years had become the assistant director of a conservatory of music. Without apparent design, she chose friends who would not be curious about her past and thus soon came to establish a new identity which removed the need for self-questioning. The patient lived this way for four years until she was finally identified by a college acquaintance who had known both her and the true Rose P. Under treatment, the patient came to recognize her real identity and the underlying causes of her fugue. Fortunately, her husband proved understanding and cooperative, and she eventually readjusted to a relatively full and normal life (Masserman, 1946).

Multiple personality. The most extreme form of dissociation is multiple personality. In this type of reaction—which is very rare, despite being dramatized so often in the movies and on television—the individual may develop two (or sometimes more) distinct personalities which alternate in consciousness, each taking over conscious control of the person for varying periods of time. Each part of the multiple personality is based on sets of motives that are in conflict with the motives of the other parts. These conflicting motive patterns originally ex-

isted simultaneously in one personality but were so incompatible—and yet all so insistent—that the person was able to satisfy them all only by repressing consciousness of one set while temporarily gratifying another set.

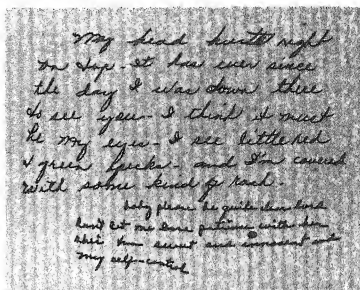
Because multiple personalities represent conflicting sets of motives, the individual's behavior is usually like that of "Dr. Jekyll" and "Mr. Hyde." If one part of a dual personality is selfish, the other is generous to a fault; if one is quiet and obedient, the other is violently aggressive. Thus the individual may be, at different times, two entirely different people—so completely so that his two personalities even go by different names. Usually, though not always, each personality is completely unaware of the other. In some cases one personality may be completely aware of the thoughts and actions of the other but not vice versa.

Students frequently make the error of confusing such cases of multiple personality with so-called "split personality," technically known as *schizophrenia* (page 486). Entirely different from multiple personality, schizophrenia is the most common of the psychotic disorders. The term "split personality" does not mean that the personality is split into conflicting parts but that the personality has been "split off" from reality, which is the principal characteristic of a psychosis. Multiple personality, on the other hand, is a neurosis in which the conscious part of the personality is in contact with the real world, although reacting to it neurotically.

This dramatic form of reaction is illustrated by the widely publicized case of Eve White. Eve, twenty-five years old and separated from her husband, had sought therapy because of severe, blinding headaches, frequently followed by "blackouts." During one of her early therapy sessions Eve was greatly agitated; she reported that she had recently been hearing voices. Suddenly she put both hands to her temples, then looked up at the doctor with a provocative smile and introduced herself as "Eve Black."

It was obvious from the voice, gestures, and mannerisms of this second Eve that she was a separate personality. ♦ She was fully aware of Eve White's doings, but Eve White was unaware of Eve Black's existence. Eve White's "blackouts" were actually the periods when Eve Black was in control, and the "voices" marked unsuccessful attempts of Eve Black to "come out." It

♦ The week before this session, the therapist had received a letter from Eve including the two paragraphs below, in different styles of handwriting. Eve denied having sent the letter; she remembered having started a letter to him but believed she had destroyed it before it was finished.



became evident that Eve Black had existed since Eve White's early childhood, when she occasionally took over and indulged in forbidden pleasures, leaving the other Eve to face the consequences. This habit had persisted, and Eve White frequently suffered Eve Black's hangovers.

After about eight months of therapy, a third personality appeared. This one, Jane, was more mature, capable, and forceful than the retiring Eve White; she gradually came to be in control most of the time.

Electroencephalograms of Jane and Eve White were both normal and very similar; Eve Black's was classified as borderline normal. Personality tests showed that Eve White had an essentially normal outlook on life but an unsatisfactory concept of herself (Osgood and Luria, 1954). Eve Black perceived herself as perfect but had a highly distorted outlook on life. Jane had the most satisfactory pattern, accepting (superficially, at least) both herself and cultural values.

As the therapist probed the memories of the two Eves, he found that as a girl Eve White had felt rejected by her parents, especially after the birth of her twin sisters. Poverty and the strict discipline of her mother may also have contributed to her unhappiness. But the therapist felt sure that some shocking event must have precipitated the actual development of distinct personalities in the disturbed child.

In a dramatic moment, the climax of therapy, the missing incident came to light. Jane suddenly stiffened, and in a terrified voice began to scream, "Mother . . . Don't make me! . . . I can't do it! I can't!" When the screams subsided, a new—and final—personality took over. She was able to recall the shocking event that lay at the bottom of the personality dissociation. At the age of six (only a few months after the birth of the hated twins) Eve White had been led by her mother to her grandmother's coffin and been forced to place a good-bye kiss on the dead face.

The resolved personality, who called herself Evelyn, later identified herself more with Jane than with either of the two Eves, though she was a more substantial and complete woman than Jane had been. She married a young man Jane had been dating, and was able to achieve a stable family life (Thigpen and Cleckley, 1954, 1957; Thigpen, 1961).

Conversion Reaction

One of the most intriguing neurotic reactions to excessive frustration is *conversion reaction*, formerly called *hysteria*, in which the patient's psychological distress is "converted" into bodily disturbances. In this form of neurosis, physical symptoms appear that have no organic basis. Indeed, many hysterical symptoms are completely incompatible with medical fact. For instance, in certain types of hysterical anesthesia (loss of sensitivity to touch or pain), areas of the body are affected which do not correspond with the actual arrangement of the neural pathways. In other cases, however, a physician may have great difficulty in telling whether the patient is suffering from an organic ailment or a hysterical one.

It is important to remember that in a conversion reaction no actual biological change is involved. This is clearly demonstrated by the fact that when the individual is asleep or under hypnosis his hysterical symptoms generally disappear. For instance, a patient who suffers from hysterical paralysis may be entirely incapable of moving his legs, but under hypnosis he may be made to get up and walk across the room. Moreover, hysterical symptoms may come and go or even appear at different times in different areas of the body; the patient who is hysterical-

ly "blind" in his right eye on one day may unconsciously shift his ailment to the left eye on the next day.

The dangers of combat and training for combat are frequent sources of conversion reaction. We are not referring to deliberate faking of illness, or *malingering*. A conversion reaction is usually more subtle and is completely without conscious intent. Being unconscious, it can provide an honorable escape from the conflict between fear of injury and fear of social disapproval.

Although hysterical symptoms may sometimes be made to disappear by means of hypnotic suggestion, they are fairly likely to recur, perhaps in modified form, as long as the underlying conflict remains. A typical case is described below.

The patient's illness had begun in early childhood. As the youngest of four girls, she was "babied" a good deal, being given her own way and seldom required to help with household tasks. Even as a child she suffered from constipation and "stomach trouble" and was subject to nightmares and fear of the dark, of death, and of illness. Although she had many girl friends, she was rather prudish about going with boys. Nevertheless, she married at the age of nineteen, having no knowledge of sex whatsoever. After their marriage night she told her husband that she was sorry she had married him. She stayed with him, however, despite numerous quarrels. Her first child, born after long and difficult labor, died within a week, and she remained in bed for four months. About six years later a son was born. Although this delivery was a rather easy one, she stayed in bed for three months, constantly complaining.

By the time her son was six years old, she had taken to a wheel chair. Twelve years later, shortly after the family had moved to a new home, she took to her bed permanently, refusing even to get up to go to the toilet. She was then admitted to a hospital, where examination showed her condition to be purely functional, although prolonged disuse had made her leg muscles flabby and weak and she required calcium, massage, and other forms of treatment to strengthen the bone and tendons of her ankles. She talked a great deal about her condition, insisting that it all stemmed from having got up too soon after the birth of her son and having worked too hard all her life. She seemed incapable of planning for the future and showed no interest in it. It appeared that she was merely continuing her childhood pattern of meeting difficulties with temper spells and complaints of

illness. The shock of her sudden sex discoveries when she married had intensified these reactions.

Three weeks of intensive therapy strengthened her legs sufficiently to enable her to walk again, and she spent five months on a gradually increasing program of daily walking exercises. Meanwhile, in psychotherapy, she was helped to understand how she had used physical complaints in order to escape from the responsibilities she found so distasteful. Since her home situation could not be favorably adjusted, she went to live with a sister in Florida and was able to make a fair social adjustment there (Strecker and Ebaugh, 1940).

The individual who displays hysterical symptoms is generally quite unaware that they are in disagreement with medical fact. Historically, the incidence of these reactions has shown a marked decrease during the past few decades as the public has gained increasing medical knowledge about organic disorders. It is more than mere coincidence that modern examples of dramatic "faith cures" of individuals who have been "struck" blind or lame are relatively rare as compared with their incidence a century ago. Conversion reactions today are most frequently observed among children and among adults whose intellectual level is somewhat lower than that of neurotics in general.

Asthenic Reaction

Closely related to conversion reaction is *asthenic reaction*, formerly called *neurasthenia*. The individual suffering from neurasthenia feels tired all the time and suffers from unpleasant physical sensations such as mysterious "shooting pains," ringing in the ears, and palpitation of the heart. These physical symptoms result from long-continued frustration that drains the person's energy and causes him to feel tired and vaguely unwell. He blames these symptoms for his failure to get satisfaction from life, although both his symptoms and his lack of satisfaction are really caused by his emotional frustration.

Asthenic reaction is often difficult to diagnose because the symptoms are less specific than those occurring in conversion reaction—the patient just feels run down, worn out, and fatigued. The role of muscular tension in such

fatigue was discussed in Chapter 11. The nervous housewife or the chronically exhausted businessman is frequently asthenic. Since such symptoms can also develop from purely physical causes, it is important, for effective treatment, to determine whether a given case is an asthenic reaction or a physical ailment. If it is physical, rest or medical treatment is indicated; but if it is asthenic, the patient should be encouraged to try to achieve real satisfaction in his emotional life and in social activity.

Neurotic individuals frequently show an extreme concern about their health and physical condition, dwelling morbidly upon every minor bodily sensation as a possible sign of some dread organic disorder. Such a preoccupation with the body's activities is called *hypochondria*. If his stomach aches, the hypochondriac is sure he has an ulcer; if he develops a slight cough, he "knows" it is tuberculosis.

Some hypochondriacs report feelings of anxiety and depression. They frequent clinics and consult numerous physicians, seeking examinations for suspected cancers, tumors, and other diseases. They are greedy readers of popular medical literature and engage in orgies of self-pity, self-diagnosis, and self-treatment. Other hypochondriacs "enjoy poor health." They take an exaggerated interest in their bodily functions, delighting in recounting details of past operations and describing their "symptoms" at great length to anyone who will listen.

Depressive Reaction

In the neurotic depressive reaction, the person distorts reality in degree rather than kind. He reacts to a loss or threatened loss with greater sadness and for a longer time than most people would. In addition to being depressed, patients often complain of inability to concentrate, lack of self-confidence, sleeplessness, boredom, irritation, and ill health. They consciously recognize the source of their frustrations, but they overestimate its significance.

The following conversation between a patient and her doctor illustrates this type of reaction.

PT: "Well, you see, doctor, I just don't concentrate good, I mean, I can't play cards or even care to talk on

the phone, I just feel so upset and miserable, it's just sorta as if I don't care any more about anything."

Dr.: "You feel that your condition is primarily due to your divorce proceedings?"

Pt.: "Well, doctor, the thing that upset me so, we had accumulated a little bit through my efforts—bonds and money—and he (sigh) wanted one-half of it. He said he was going to San Francisco and get a job and send me enough money for my support. So (sigh) I gave him a bond, and he went and turned around and went to an

attorney and sued me for a divorce. Well, somehow, I had withstood all the humiliation of his drinking and not coming home at night and not knowing where he was, but he turned and divorced me and this is something that I just can't take. I mean, he has broken my health and broken everything, and I've been nothing but good to him. I just can't take it doctor. There are just certain things that people—I don't know—just can't accept. I just can't accept that he would turn on me that way." (Coleman, 1964, p. 229)

PSYCHOTIC REACTIONS

When frustration and stress become so overwhelming that the individual loses contact with reality, his condition is described as *psychotic*. So disabling is the disturbed mental functioning and distorted behavior of psychotic patients that they nearly always must be placed under institutional care.

In laymen's terms, psychotics are usually considered "insane." Strictly speaking, *insanity* is not a psychiatric or psychological term but a legal concept applied to any mental condition that renders the individual incapable of knowing right from wrong and therefore of being legally responsible for his actions. Thus insanity would include not only psychotic disorders but also extreme, severely incapacitating neurotic reactions.

In spite of the fact that neurotic and psychotic symptoms overlap to a considerable degree, individuals suffering from neurotic disorders seldom become psychotic, even in the face of increased frustration. Psychotic behavior usually develops suddenly without the forewarning of severe neurotic symptoms, although the frustrations that cause the person to break contact with reality may have been active for years. Borderline symptoms, difficult to diagnose as either psychotic or neurotic, are frequently called *pre-psychotic*.

In most cases psychotic reactions are clearly recognizable by their bizarre symptoms. Psy-

chotic patients generally do not display the anxiety characteristic of neurotics—in denying reality, they no longer recognize the existence of their conflicts and fears. That they are out of touch both with their own past experience and with the world around them has been shown by laboratory studies as well as by clinical observation (Dowis, 1964). Whereas neurotics are usually aware of the abnormal nature of their symptoms, psychotics rarely recognize that any of their actions or experiences are at all out of the ordinary. To the psychotic there is little distinction between fantasy and fact—fantasy is fact to him, and he behaves accordingly.

Characteristics of the Functional Psychoses

Psychoses may be classified on the basis of their origin as either *organic* or *functional*. The functional psychoses, the only ones with which we shall be concerned, are those which have no identifiable organic source. They fall into four major classifications, as shown in the chart on page 486.

Although there are four distinguishable patterns, psychotics are alike in showing loss of contact with reality and marked disturbances in behavior and thought processes. Three types of symptoms that appear—either singly or in various combinations—in all the psychoses are de-

CLASSIFICATION OF THE FUNCTIONAL PSYCHOSES

Disorder	Major Symptoms	Major Subgroups	
Schizophrenic reaction	Retreat from reality, with emotional blunting, inappropriate emotional reactions, and marked disturbance in thought processes; delusions, hallucinations, and stereotypies common.	Simple Hebephrenic Catatonic Paranoid Childhood	Acute undifferentiated Chronic undifferentiated Schizo-affective Residual
Paranoid reaction	Logical, often highly systematized and intricate delusions with personality otherwise relatively intact.	Paranoia Paranoid State	
Affective reaction	Extreme fluctuations of mood, with related disturbances in thought and behavior.	Manic-depressive Psychotic-depressive	
Involuntional psychotic reaction	Abnormal anxiety, agitation, delusion, and depression; occurs in later years, without previous history of psychotic reaction.	Characterized chiefly by depression Centering around paranoid ideas	

lusions, hallucinations, and distorted emotional behavior. *

Delusions. (A strong belief which is opposed to reality but which the individual steadfastly maintains despite all evidence of its untruth is called a *delusion*.) Patients who experience persistent delusions are said to be *paranoid*.

There are three main types of delusions; the most common kind is the *delusion of grandeur*. The patient believes he is some exalted being, such as an emperor, a millionaire, a great inventor, or even God. One woman patient in a mental hospital had a pleasing personality and was well enough adjusted in most ways to be trusted with many duties, including that of helping show visitors through the institution. But nothing could shake her firm conviction that she was really Bing Crosby's wife.

A second type of delusion is the *delusion of reference*. In this case the individual misconstrues chance happenings as being directly aimed at him. If he sees two people in earnest conversation, he immediately concludes that they are talking about him. If his bed is

changed to a new position in the ward, it is because the attendants are displeased with him and want to guard him more closely or because he is being rewarded for good conduct. Nothing is too trivial or too accidental to escape notice as having some personal significance.

The third common type of delusion is the *delusion of persecution*. Here the individual is constantly on guard against his "enemies"—he feels that he is being spied upon and plotted against, and is in mortal danger of attack. Delusions of persecution may accompany delusions of grandeur—the patient is a great man, but he is opposed by evil forces.

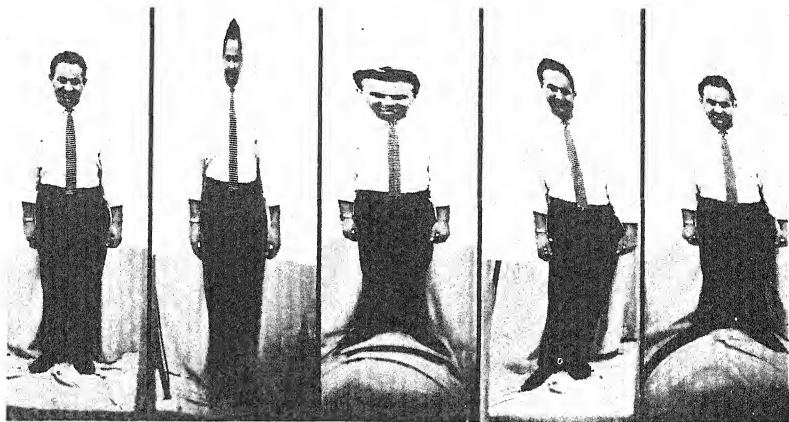
The following illustration presents a typical case involving delusions of persecution:

"... A woman of 75 ... believed that her son-in-law planned to sexually assault and kill her. Her reaction to this idea was expressed in many letters sent to friends and relatives, mailed surreptitiously, and causing the daughter and son-in-law much embarrassment. Aside from this idea, the woman behaved normally. ... As she became friendly with the examiner she began to verbalize her delusion, explaining that she

based her idea on the fact that articles in her room were sometimes disarranged, that the son-in-law walked past her door unnecessarily or looked at her in a strange manner. Becoming enthusiastic about her subject, she suddenly stated that her daughter's husband was really a reincarnation of a lover of the patient in her youth. She brought out an old picture to verify the resemblance and then launched into a story of the man to whom she as a girl had been engaged. . . ." (Bosselman, 1953, pp. 119-120)

When a patient is pressed to account for the discrepancy between his delusion and present

reality, he frequently resorts to some substantiating, or secondary, delusion that is just as real to him as the primary delusion. For example, if a patient who believes himself to be St. Peter is asked why he is scrubbing the floor of the hospital ward, he may reply that he has been sent to earth in disguise to find out which persons are obeying the will of God and which ones are not. He will explain that he is keeping a list of the moral transgressions of patients and staff members and that the evildoers will be punished, even as the good will be rewarded. The development of such secondary delusions is evi-



● An ingenious device for getting objective measures of distortions in schizophrenics' perceptions of themselves is the distorting mirror shown here. The flexible surface of the mirror can be made to represent an undistorted view (left), or differing degrees and placements of horizontal and/or vertical distortions. Starting with a grossly distorted convex view, the subject watches as the distortion is lessened; he is instructed to say "Stop" when it looks like him. The process is then repeated with an image distorted on the concave side, to determine the range within which the image appears undistorted to the subject.

Schizophrenics find acceptable a far wider range of mirror positions than do normals, apparently confirming clinicians' reports of gross distortions of body image among such patients (Orbach, Traub, and Olson, 1966). Continued research, however, indicates that schizophrenics also show considerable deficit in judging distortion of other images, leading the investigators to conclude that the deficit relative to body image does not indicate a distorted body concept per se but is part of a general picture of distorted perception, intellectual deterioration, and motivational factors (Traub, 1966).

dence of the faith the individual has in his original delusions. To him they are so real that it never occurs to him to question them. If they are discrepant with what other people say, then the other people must be wrong.

Hallucinations. Psychotic patients (especially schizophrenics) frequently experience hallucinations—sensory impressions of external objects in the absence of any appropriate stimulus in the environment. Such extreme distortions of reality are difficult for another person to interpret, although they have meaning to the disturbed person. Most frequently, hallucinations are auditory—the individual hears strange, confusing noises or voices which speak to him in command or criticism. Such auditory hallucinations often fit into a delusional system. For example, if the patient thinks that he is a religious prophet, he may receive hallucinatory messages which he believes come from God. In other cases the patient has no idea who is “talking” to him, although he may carry on lengthy conversations with the hallucinatory intruder.

Psychotic patients may also experience hallucinatory tastes and smells. These frequently accompany delusions of persecution. The patient may complain that his enemies have released poisonous gas into his room or placed some odd-tasting poison in his food. Visual hallucinations are comparatively rare in functional psychoses, although they are common in some organic psychoses such as *delirium tremens*, resulting from severe alcoholism. When they do occur in functional disorders, they usually take the form of “visions” in which God or a saint makes some revelation to the patient.

Emotional distortion. The emotional behavior of psychotic patients is usually distorted, either by a general blunting of emotional responsiveness or by exaggerated displays of gloom, elation, fear, anger, or sexual behavior.

Catatonia. In one schizophrenic reaction known as *catatonia*, the patient has episodes during which he remains completely motionless and unresponsive to any type of stimuli, sometimes maintaining a single posture for hours. Catatonic stupor represents extreme apathy and withdrawal from reality. Nevertheless, patients often recover, as in the following case.

A brilliant student, Clarence suffered a severe breakdown during his third year of college and was admitted to a mental hospital. While he was in the hospital, Clarence heard voices and often talked of a machine to control human thoughts. Once the therapist approached him on the hospital grounds and called his name but was unable to get his attention. Clarence was staring into space, the tip of his index finger pressed against his lips. The therapist found it difficult to move the finger but finally succeeded in raising Clarence's arm above his head. There it remained, in the awkward position in which the therapist had placed it. The therapist pinched Clarence and even stuck him with a pin, but Clarence did not move an eyelid. He was in a catatonic stupor.

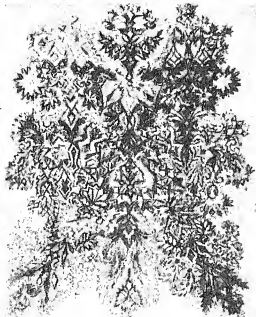
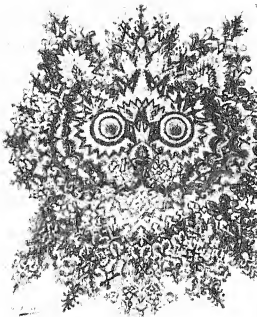
For ten days he remained silent and motionless and had to be forcibly fed. Then suddenly he emerged from the stupor, exclaiming, “I have been born again.” After this, he improved rapidly and was able to respond to psychotherapy. At the time his case was written up, he had been well for two years, and was planning to return to college the next year (Strecker, 1952).

Depressive and manic episodes. In some psychotic disorders the patient's predominant symptom is a generalized slowing down of mental and physical activity, accompanied by gloom, morbid thoughts of disease and death, and feelings of worthlessness. During such depressive episodes, patients frequently attempt to commit suicide and must be carefully watched. The speech of psychotically depressed patients is slow and laconic; when they do speak, it is generally to express their suffering and suicidal desires.

In sharp contrast to psychotic depression is the manic reaction, which is characterized by high excitement, elation, and restless activity. The manic patient indulges in frequent boisterous laughter and eloquent, loud speeches. He walks about wildly and gestures dramatically, banging upon the walls and furniture.

Most patients show only a manic pattern or only a depressive one, but some alternate between manic and depressive periods, as in the following case. Often there are long periods of apparent normality between episodes.

Elizabeth showed a severe manic-depressive psychosis. From her late twenties until her death at fifty-four she alternated regularly between depression and mania, these states being exactly equal in length. During her



◆ The distortions of perception characteristic of schizophrenic patients are vividly revealed in a series of paintings by an English artist, Louis Wain, an eccentric bachelor who had made a specialty of making portraits of his seventeen cats before suffering a schizophrenic breakdown in middle life. Five of the paintings made during his breakdown and subsequent relapses are shown here. The cat becomes more horrifying and the background more bizarre and abstract until finally the cat disappears entirely.

depressions she sat slumped in a chair, scarcely moving, feeling miserably unhappy. During the manic periods she was a whirlwind of misdirected energy. She would often smear her face and body with lipstick, put on a headdress made of grapefruit rinds and bits of cloth, tie red rags around her legs and arms, and sing at the top of her voice, "I'm a copper-colored maiden." For hours at a time she would talk so rapidly that she could scarcely be understood. One fragment of her cascade of speech was the following: "Will you come to a Hal-lowe'en dinner and dance . . . at least 100 crazy loons and 100 nurses, also your friends from the east, also your former enemies . . . Louis will bring a zither player, a glass of wine, some angel cake, and you —music that I heard from you was more than music,

bread that I broke with you was more than bread." (Strecker and Ebaugh, 1940)

(Severe manic and depressive episodes represent emotional distortion in its extreme form.) More often the emotional behavior of psychotics is merely inappropriate to the situation; they may giggle frequently for no apparent reason, suddenly break into tears, or change rapidly from one mood to another. But whatever specific symptoms a psychotic patient may display—whatever combination of delusions, hallucinations, and emotional distortion—the essential fact remains that he is to some extent out of tune with reality. ◆

Origins of Psychotic Behavior

As already indicated, psychoses have traditionally been divided into two categories—organic and functional. An *organic* psychosis is a disorder resulting from an irreversible injury to the nervous system, sustained through disease or bodily injury, or from a reversible condition such as malnutrition, glandular deficiency, certain infections, and some little-understood chemical conditions. A *functional* psychosis, on the other hand, is precipitated primarily by psychological factors. Disorders involving neural damage tend to be permanent, but most functional psychoses, if given adequate and early psychiatric treatment, can be cured.

Whether any organic changes occur in functional disorders is an open question, partly because present laboratory techniques are inadequate for identifying minute neurological changes. It can only be said that no *observable* structural changes underlie these psychoses.

Hereditary factors. Although functional psychoses are precipitated primarily by psychologi-

cal factors, heredity may play a role in their development. Numerous studies have indicated that psychotic disorders tend to run in families. This fact is not in itself a proof that such conditions are hereditary, since a poor heredity and an unfavorable environment usually go together. The hypothesis of heredity gains strong support, however, from the fact that identical twins of psychotics show more tendency to mental disorder than do fraternal twins.

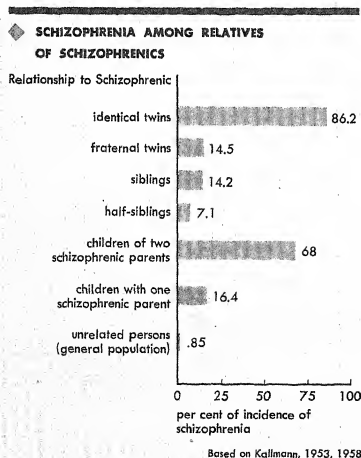
One investigator found that in 76 per cent of the cases studied where schizophrenics had an identical twin, the other twin was also schizophrenic. This was true in the cases of only 14 per cent of the schizophrenics who had fraternal twins (Slater, 1953).

In another study, analysis of the family histories of over 1000 patients who had been diagnosed as schizophrenic revealed that the statistical probability of a person's developing schizophrenia is directly related to his degree of genetic relationship with a schizophrenic patient, as shown in the graph. ♦

Note that the full sibling of a person with schizophrenia is eight times as likely to develop the condition as is the step-sibling even though both usually grow up in the same home environment. There is, however, no difference between full sibling and fraternal twin, whose genetic resemblance is the same. This study also found that the incidence of schizophrenia among children in families where one parent had schizophrenia was 19 times greater than in the general population, and where both parents were schizophrenic the incidence rate for their children was 85 times greater than the normal incidence (Kallmann, 1953, 1958).

Although genetic factors are undoubtedly involved in the development of functional psychoses, it cannot be concluded that such psychotic disorders are directly inherited. Most psychologists and psychiatrists agree that what can be inherited is a *predisposition* to the psychosis; under conditions of severe frustration, a predisposed individual is believed to be more likely to develop a psychosis than other individuals, who more probably would develop some less severe disorder.

It has been argued by some clinicians that identical twins develop confusion of identity



because of being dressed and treated alike and hence are more prone to schizophrenia than are other individuals. The available evidence, however, refutes this. One investigator found that both in Sweden and Germany the frequency of twins among schizophrenics is actually less than the estimated frequency of twins in the general population (Rosenthal, 1960).

Body chemistry factors. The study of internal chemistry in relation to psychosis has revealed evidence that manic-depressive and schizophrenic patients differ measurably in blood chemistry from each other as well as from normal individuals. The interpretation of such differences requires great caution, however; they may be a result of the psychosis rather than a cause of it. It is reasonable to assume that a psychosis, through disruption of normal activity and interference with nutrition and sleep, might have extensive effects on the body chemistry.

Investigators have found that the blood of schizophrenics contains less of a substance called *glutathione* than does the blood of normal individuals (Martens *et al.*, 1956) but a greater than normal quantity of *ceruloplasmin*, a substance containing copper, which makes schizophrenic blood able to oxidize adrenaline more rapidly than can normal blood (Leach *et al.*, 1956; Leach and Heath, 1956).

A number of studies have investigated the effects of *taraxcin*, a substance extracted from the blood of schizophrenic patients.

After careful preliminary tests on monkeys, a series of experiments was conducted on human subjects, chiefly prisoners who volunteered to take part in the study. Those who received injections of *taraxcin* developed schizophrenic symptoms lasting about two hours, whereas control subjects receiving a similar substance extracted from normal blood did not. Although the symptoms varied greatly, all those who received *taraxcin* reported marked disorganization of thought and inability to concentrate (Heath, 1960; Heath, Martens, Leach, Cohen, and Angel, 1957; Heath, Martens, Leach, Cohen, and Feigley, 1958) ⁶

These findings have been verified and extended in subsequent research with human subjects and monkeys (Heath, 1966; Heath and Krupp, 1967; Heath, Krupp, Byers, and Liljekvist, 1967a, 1967b).

● This picture shows a volunteer subject after an injection of a substance isolated from the blood of a schizophrenic patient. He showed typical symptoms of schizophrenia, felt that everyone hated him, and in return felt an urge to hurt everyone around him.



Studies have also been made with the drugs *mescaline* and *lysergic acid diethylamide* (LSD). These drugs produce some temporary symptoms of mental illness in normally healthy individuals. There are important differences between these drug states and true mental illness, but they do have much in common. Psychiatrists are using the drugs in the hope of learning more about real mental disease.

Recently, LSD has come to be resorted to by individuals seeking escape from reality. While it is not addictive, LSD is so powerful in its effects on perception and personality that its use by the untrained is extremely dangerous.

Under LSD, some individuals undergo ego constriction, others experience ego expansion, while still others react in ways which do not appear to involve ego change (Kuramochi and Takahashi, 1964). The individual's motivation

in taking psychedelic drugs may be an important factor in their effect, as may his personality structure. Obviously, only a highly trained therapist is able to predict the kind of reaction a given individual is likely to experience and to deal with it appropriately. For the individual taking LSD can be described as temporarily schizophrenic. He experiences hallucinations and other schizophrenic symptoms. In fact, the electroencephalograph has shown that the EEG's of normal subjects under the influence of LSD are similar in some respects to those of schizophrenics (Pfeiffer, Goldstein, Murphree, and Sugarman, 1965).

Taking LSD in an effort to enhance verbal performance would appear to be a mistake, in view of the findings of a study on the temporal effects of that drug and of the stimulant epinephrine on the ability to communicate.

Ten normal male subjects recorded spontaneous speech samples before and at various intervals after taking one or the other of the drugs. Typescripts of these speeches with every fifth word left out were later presented to normal subjects not under the influence of drugs with instructions to fill in the omitted words. The speech samples were scored for "understandability" according to how well the words inserted agreed with the original. Although epinephrine enhanced understandability as so measured, LSD significantly impaired it (Honigfeld, 1965).

On the basis of findings to date, the best conclusion is that LSD belongs in the laboratory and the clinic, not in the parlor or the dorm.

Environmental factors. Although the exact degree to which heredity and environment interact in the development of functional psychoses is unknown, both factors are unquestionably important. Clinical psychologists are convinced that the emotional problems responsible for the development of psychotic behavior in adults can in most cases be traced to early childhood experiences. Faulty parent-child relations, for example, are frequently found to underlie the appearance of psychotic patterns in later life. Just as genetic factors can predispose an individual biologically, so environmental factors

such as parental rejection or overprotection, excessive or inconsistent discipline, or extreme insecurity can predispose him psychologically to mental illness in adulthood.

In one study, 100 mothers of male schizophrenics and 100 mothers of normal men were asked to indicate which items they agreed with in a list of statements regarding the proper rearing of children. The mothers of the schizophrenics believed in allowing children much less freedom than did the other mothers. Among the items with which most of the mothers of schizophrenics agreed and most of the other mothers did not agree were: "Children should be taken to and from school until the age of eight just to make sure there are no accidents"; "If children are quiet for a little while a mother should immediately find out what they are thinking about"; "Children should not annoy parents with their unimportant problems"; and "A child should not plan to enter any occupation that his parents don't approve of" (Mark, 1953).

A more recent study found the mothers of young adult schizophrenics to be cold and withdrawn as compared to those of normal young adults (Check, 1964). A less direct approach has also indicated that the schizophrenic's early relations with his mother or other female authority figures tend to be unsatisfactory.

In this study schizophrenics, normal adults, college students, children nine to twelve years of age, and children five to eight years of age were shown nine moon faces differing in expression and asked, when given a word, to point to the face that was most appropriate to that word. The schizophrenics chose significantly less happy faces in response to the words "mother" and "teacher" than did the other groups (Iscoe and Veldman, 1963).

On the other hand, slightly different results were obtained from a group of 80 neuropsychiatric soldier patients and 117 normal soldiers who completed an inventory of their parents' child-rearing behavior as they remembered it. The patients did not remember their mothers significantly differently than did the normal soldiers. However, the fathers of the normal men were remembered as having been more supportive and giving in their relationship with their sons and as having encouraged social and intellectual growth to a greater extent than the fathers of the patients (Vogel, Livingston, Lauterbach, and Holloway, 1964).

One of the greatest misfortunes that can befall a child is the loss of one or both parents.

A recent comprehensive study has shown that female alcoholics, psychoneurotics, and schizophrenics are much more likely than average to have lost their mothers at an early age. Males do not seem to be so adversely affected by the early loss of the mother. Female alcoholics and female schizophrenics are also much more likely than the average individual to have lost their fathers at an early age (Hilgard and Newman, 1963).

Obviously, the loss of a parent at an early age can be an emotionally damaging experience.

The broader cultural environment also appears to play some part, at least in determining the form psychosis will take. Just as the neurotic conversion reaction is less common today than formerly, manic-depressive psychosis also appears much less often in mental hospitals than it did twenty or thirty years ago (Lundin, 1961). Of course, it is possible that a number of psychotics who would formerly have been classed as manic-depressive are now diagnosed

as suffering from some form of schizophrenia. Also, with modern advances in therapy more patients can be treated at home. Nevertheless, there do appear to be "styles" in psychosis, such as the "dancing mania" (*tarantism*) prevalent in Italy and Spain in the seventeenth century, or the medieval disorder known as *lycanthropy*, in which the patient believed himself to be a wolf. With wolves no longer a threat, the psychotic thinks he is something else—a Martian, perhaps.

Experimental Study of Psychotic Behavior

Although numerous animal studies have been made, it is only recently that experimental analysis of abnormal behavior in human beings has been attempted. In 1954 a technique was developed by which abnormal human behavior could be studied under controlled conditions. Based upon the bar-pressing method of studying operant conditioning in rats, the new procedure employs an apparatus adapted specifically for use with mental patients.

The devices are located in soundproof rooms within the hospital. Each room contains only a chair and a plastic ash tray, in addition to the response mechanism, called the *manipulandum*, and the dispenser, similar to a candy dispensing machine. The *manipulandum*, a metal plunger, can be pulled as fast as 10,000 times per hour, although reinforcements (usually candy or cigarettes) are delivered according to the schedule being used in a given experimental session. Complex timers and recording devices operate behind the scenes to measure the rate of response, and the experimenter can observe the subject's behavior through a one-way screen.

Records of the performance of some fifty chronic psychotic patients show that they pulled the knob much less regularly than did normal individuals. In fact, irregularity of response proved to be one of the most valid indications of psychosis, increasing with the severity of the patient's condition.

On a variable schedule of reinforcement, psychotics were likely to respond fairly regularly for a time but often paused for rather long intervals during which they engaged in their own particular symptoms—pacing the floor, talking to themselves, etc. Whatever specific psychosis the patient suffered from, the pauses were longer and more frequent when his condition was worse.

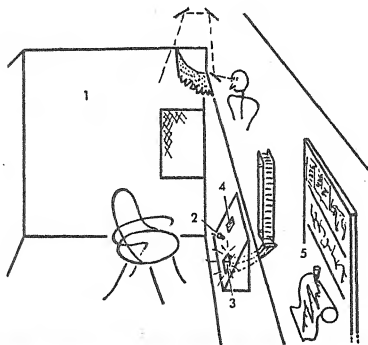


Diagram of the experimental room and manipulandum. The numbers indicate: (1) plexiglass window to adjoining room, (2) plunger to be pulled, (3) reinforcement magazine, (4) stimulus panel, (5) automatic controlling and recording mechanisms.

To make sure that poor response rates were not due to ineffective reinforcers, a variety of rewards were tried with both psychotics and normals. The response rate of normal adults working for nickels was adopted as a standard of comparison. On the average, psychotics worked best for candy.

Interesting results were obtained through the use of a "social" reinforcer in the form of a hungry kitten placed behind the plexiglass window of the dispensing apparatus. When the patient pulled the knob a dipper of milk was made available to the kitten for five seconds. Some patients responded at high rates until the kitten was satiated. Others, however, appeared to get little reinforcement from watching the kitten eat, since they responded at lower rates than for other reinforcers. ▲

You will recall that extinction of a conditioned response occurs when reinforcement is withheld for a time. This phenomenon was evident in the case of normal individuals. However, psychotics seeking candy continued to respond hour after hour and day after day with no reinforcement, to the extent that the experimenters decided that extinction must not be occurring at all.

Patients with poor response rates also showed results typical of psychotic individuals when tested with such

instruments as the Wechsler-Bellevue intelligence test or the Rorschach inkblot test. Only about 40 per cent of a mental hospital population can be given such tests, however, whereas 80 per cent of such patients can be studied by use of the manipulandum apparatus. Thus the device is able to provide a good indication of severity of disturbance for a much greater number of chronic patients than can other measuring instruments now being used (Skinner, Solomon, and Lindsay, 1954; Lindsay, 1956a, 1956b).

The operant conditioning method of measuring the severity of psychotic disturbance also shows promise as a sensitive measure of changes in behavior produced by drugs. To date great individual differences in response to therapeutic drugs have been found. Several patients who showed no change in behavior in the ward did show increased rates of pulling the manipulandum, indicating some effect of the drug they had taken (Lindsay, 1958).

All in all, the use of the experimental method in studying psychotic patients shows a great deal of promise.

ALCOHOL, DRUGS, AND GAMBLING

Alcohol or drugs are often used as a means of escaping the frustrations of life. Estimates vary widely, but there are nearly 5,000,000 excessive drinkers in this country and about 60,000 persons who are addicted to narcotics (National Education Association, 1957; U. S. Treasury Department, 1962). Modern clinicians agree that chronic and excessive use of alcohol or drugs is not so much a moral problem as a symptom of a severe emotional disorder.

Alcoholism

How to control excessive drinking is one of the constant problems facing society. This problem is made especially difficult because

only the drinker who wants to be helped can be helped. Although reaction time is lengthened and automobile driving performance is impaired at low blood alcohol levels (Carpenter, 1962), many people can drink moderately without having their use of alcohol seriously interfere with normal living.

One investigator has identified three kinds of drinking (Sanford, 1965). These are *facilitative*, *integrative*, and *escapist* drinking patterns. Facilitative drinking is usually moderate and fosters relationships—warms people up, as at a cocktail party, and sets the stage for easy social relations. Integrative drinking contributes to group solidarity, especially on festive occasions such as weddings and political or athletic victories. Drinking of this nature is not necessarily

moderate. Escapist drinking is the type which one uses to drown the pain of life's frustrations. It is this last type of drinking that leads to the most trouble.

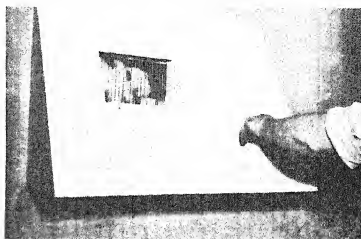
The alcoholic is an individual who feels such an uncontrollable need to drink that his economic, social, and family life disintegrate; he depends upon alcohol to get him through the day and feels he cannot face life without it. The chronic alcoholic's body tissues eventually become habituated to alcohol, while his anxieties remain insistent.

Experience has shown court punishments such as fines and imprisonment for drunkenness to be unsatisfactory means of controlling excessive drinking. Nor was another legal measure—national prohibition—successful in reducing the amount of harmful drinking. Statistics on the admission of alcoholic patients to state hospitals in New York from 1889 to 1943 reveal no relationship between legal prohibition of drinking and the incidence of alcoholism (Landis and Cushman, 1945).

One method of treatment is based on the conditioned-response principle. The patient is forced at regular intervals to drink alcohol mixed with emetic drugs so that he becomes severely nauseated. It is assumed that, since each such drink makes him ill, he will become sufficiently conditioned against liquor to stop his drinking. However, unless the patient gets at the root of his emotional problems, his need for liquor will generally be stronger than his conditioning against it, and he will continue to drink.

More effective methods of controlling alcoholism rest on the belief that drinking is primarily a symptom rather than the cause of the individual's difficulties. One such cure for alcoholism comes through personal and social psychotherapy. The therapist helps the patient work out a solution that will give him the satisfactions he is lacking. Often such therapy must be carried on in an institution where the patient can reorganize his emotional patterns without the continual temptation of alcohol as an escape. During recent years, too, many alcoholics have found new help in facing their problems through the organization known as Alcoholics Anonymous. This organization provides for its members an atmosphere of mutual un-

▲ Apparatus showing a kitten behind the plexiglass window.



derstanding, acceptance, and sympathetic fellowship in which they can work out their problems without the feelings of isolation and shame that may torture the alcoholic struggling alone. Among patients who really want to be cured, this approach to alcoholism has met with considerable success.

Experience shows that therapy works best with individuals who not only desire to be cured but have only recently begun to drink excessively. The alcoholic of long standing is rehabilitated with great difficulty if at all.

Another approach that has given promising results thus far is based on the belief that alcoholism is caused chiefly by a nutritional deficiency. Because of their heredity, it is argued, some individuals have unusually high requirements for certain food elements. If these elements are not adequately supplied, such people may turn to alcohol to satisfy their cravings. This explanation of alcoholism is based on animal experiments.

In one experiment, for example, rats that had free access to a dish of water and to a dish of 10 per cent alcohol showed wide variation in their tendency to drink the alcohol. After being placed on a diet that was deficient in the B complex vitamins, all the rats began consuming a great deal of alcohol. When they were returned to an abundant diet, their alcohol consumption dropped overnight. However, different rats responded to different combinations of vitamins (Williams, 1951).

On the basis of such studies, a potent and specially compounded vitamin capsule was administered to a number of alcoholics. Although some neglected to take the capsules, those who were faithful in continuing the treatment were, without exception, wholly or partially cured: Once cured, furthermore, most subjects could indulge in moderate drinking without experiencing the compulsion to go on. Although this method needs further study, it may prove very valuable, especially if it is used in conjunction with psychotherapy. By freeing the alcoholic from his physical dependence on alcohol, nutritional therapy may enable him to search out and resolve the psychological causes of his difficulty.

Drug Addiction

Widespread publicity has drawn sharp attention to the "dope" problem, particularly among adolescents and young adults. Actually, however, drug addiction has declined over the period from 1914 to 1965. Contrary to "scare" journalism, fewer than 4 per cent of addicts are of high-school and college age (Federal Bureau of Narcotics, 1966). ■ Narcotic addicts seldom display any outward signs of mental disturbance other than their abnormal craving for drugs, and their general efficiency is much less impaired than the chronic alcoholic's (Pescor, 1944). Generally they are passive, immature individuals who have no constructive, satisfying role in the community.

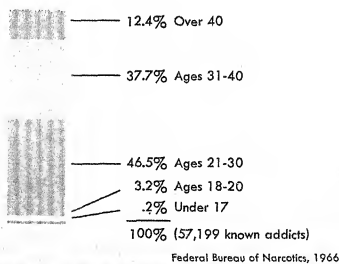
In certain other respects, however, the problem of the individual drug addict is much more serious than that of the alcoholic. If he uses either morphine or heroin (both opium derivatives), he soon develops a strong physiological dependence upon the drug, so that if he does not take it regularly—usually two or more times a day—he becomes physically ill. Furthermore, the user of opiates builds up an increasing tolerance to the drug and must take a larger and larger dosage to satisfy his need. In some cases dosage becomes so great that it leads to death.

Since the unlicensed sale and possession of narcotics is a legal offense, the addict faces another problem usually unknown to the alcoholic. Not only are drugs very expensive, but addicts must usually rely upon criminals for their

supply. Often they are driven to peddling narcotics themselves, or to thievery or prostitution, in order to pay for their drugs. It is for this reason that drug addiction is often cited as a major source of crime. Contrary to popular belief, there is little evidence that the drugs themselves lead an addict to violence. When well supplied, narcotic addicts usually feel too buoyant and good-natured to harm anyone.

Psychologically, the addict finds in his use of drugs a blissful retreat from frustrating reality. Opium, morphine, and heroin usually cause the individual to feel peaceful and relaxed. The opiates also tend to lower the individual's inhibitions and to increase his feelings of self-confidence, so that he sometimes indulges in eloquent, boastful behavior. These drugs reduce sexual drive and hence do not cause violent sex crimes as is sometimes suggested.

A person under the influence of marijuana, however, may engage in promiscuous or deviant sexual behavior. Although this drug does not act directly as a sexual stimulant, it leads to a general lowering of inhibitions and impairment of moral judgment. Contrary to popular belief, marijuana is not a narcotic and not addictive, and it has not been shown that its use leads to the use of true narcotics. Studies carried out in Morocco show that after five years or more of smoking hashish, a drug similar to but far



AGES OF NARCOTIC ADDICTS

■ Almost half of the active narcotic addicts are between ages 21 and 30. Only about a sixth are under 21 or over 40.

stronger than marijuana in the southwestern United States, there is cerebral deterioration, as evidenced by disturbances in memory, speech, orientation, and judgment (Masserman, 1967).

The successful treatment of narcotic addiction, as of alcoholism, usually requires psychotherapy to help the patient gain emotional insight into his problems and face them realistically. In addition, morphine and heroin addicts require hospitalization for medical "withdrawal" therapy. During withdrawal the patient suffers violently for several days with agonizing physical symptoms such as vomiting, diarrhea, tremors, and cramps.

The outlook for permanent cure in cases of drug addiction has been rather dim. Experience has shown that unless the individual is able to solve his underlying emotional problems, he will not permanently free himself from reliance upon narcotics. In one study it was found that 97 per cent of addicts treated at federal hospitals sooner or later returned to the use of drugs (Duvall, Lacke, and Brill, 1963).

The first step in solving the problem of drug addiction is to view it in its true light—as an illness, not a crime. The true criminals are the nonaddicted narcotic importers and peddlers, who make enormous profits from the sale of illegal drugs.

It is quite clear that medical treatment alone is not enough to enable the addict to overcome his addiction. In fact, it can only start him on the way to recovery. The patient must learn to face his problems and perform a mature role in the community. Usually it requires some form of psychotherapy over a considerable period of time if he is to succeed in doing this.

A relatively new approach somewhat similar to that of Alcoholics Anonymous is that of the therapeutic community known as Synanon (Coleman, 1964). Made up of ex-criminal addicts, Synanon was begun by a business executive, Charles E. Dederich, who had overcome an alcohol problem and was eager to share with others the experiences which had led to his recovery. A brilliant group leader, Dederich attracted a considerable group of alcoholics and drug addicts to his discussions. Some of them moved into his own house and others into nearby apartments until Synanon House was established in Santa Monica, California, in 1958. All

members of the group are part of the staff and serve as therapists for each other. Each is uniquely qualified to help addicts because he himself has a history of addiction and criminal behavior, has experienced the stress of adjusting to a new way of life at Synanon, and knows the social system of Synanon. In this way a former offender is provided with a new social role, that of serving as a therapist for other offenders, and he can perform this useful role as long as he wishes. Furthermore, he is not likely to be outwitted by the rationalizations of newcomers, since he understands exactly what they are going through. In performing this legitimate social role at Synanon, the former addict learns about community living and gradually becomes able to lead a useful life in the larger community without depending on drugs. Of course a few members decide to make Synanon their life work and either remain at the parent house or aid in establishing new Synanon projects, some in prisons, where the organization appears to be of value in providing therapy for newly admitted criminals.

Compulsive Gambling

Another form of addiction, not physiological but nevertheless capable of ruining an individual's life and profoundly affecting the lives of his family as well, is compulsive gambling. Most individuals, if they indulge in gambling, do so just for fun. They enjoy a fund-raising bingo night, an afternoon at the races, or a weekend in Las Vegas, but after these diversions they go back to everyday routine. The compulsive gambler, however, is unable to stop gambling. No matter how heavy his losses, he continues to believe that he can become rich through further gambling—often using up all his family's savings and going heavily into debt or perhaps even embezzling in order to continue.

Such individuals are usually immature emotionally and tend to act out their impulses. They are often rebellious and hostile toward others or passive and dependent (Bergler, 1957; Bloch, 1961). They usually see themselves as businessmen taking calculated risks to build up a comfortable income. Since their

family and friends do not share this point of view but regard their activities as immoral or, at the very least, extremely foolish, they come to feel alone and misunderstood. They then gamble all the more in an attempt to vindicate themselves.

Like alcoholics, such individuals should be regarded as emotionally ill persons in need of therapy rather than as criminals. There is even an organization known as Gamblers Anonymous which operates in much the same way as Alcoholics Anonymous to aid confirmed gamblers. Members meet to discuss their common problem, striving to gain insight into it. They are pledged to help any fellow member who has a relapse. Psychotherapy is often effective in the treatment of compulsive gambling, and fortunately the tendency to gamble usually diminishes somewhat as the individual grows older, even if he does not seek therapy (Coleman, 1964).

CHAPTER SUMMARY

Human adjustment is a never ending process of dealing with frustration, which may be *environmental* or *personal* in nature or may involve a *conflict* of motives. Four kinds of conflict are possible: *approach-approach*, *avoidance-avoidance*, *approach-avoidance*, and *double approach-avoidance*. Frustration and the resultant stress often play an important role in motivation, adding to the original drive. Sometimes, however, the best solution is to withdraw from the frustrating situation. The most painful frustrations are usually those which are *ego* involving. To protect the self concept against such frustrations, a number of behavioral devices known as *defense mechanisms* are employed. These may be classified as *aggressive* reactions, *flight* or *withdrawal* reactions, or *compromise* reactions.

Aggressive reactions to frustration do not always take the form of direct attack. Instead, aggression may be *displaced* onto some person

or object less threatening or more accessible than the one responsible for the frustration. The most common forms of displaced aggression are *scapegoating*, "*free-floating*" anger, and threatened or attempted *suicide*. Although the threat of punishment can be effective in controlling some kinds of aggressive behavior, actual punishment, which is itself frustrating, may increase aggression. A better method of controlling aggressive tendencies is through *controlled expression*—release of hostile feelings verbally or in other harmless or even constructive ways.

Withdrawal reactions include *repression*, the exclusion from consciousness of painful thoughts or feelings; flight into *fantasy*, as in daydreaming; *nomadism*, aimless wandering from place to place; the "*beatnik*" reaction of withdrawal from conventional modern life; and *regression* to childish modes of adjustment.

Compromise reactions to frustration include *sublimation*, the indirect expression of needs (usually of the sexual urge) in socially acceptable ways, and *substitution*, in which the conscious quality of the desire is not fundamentally changed and the means of expression are usually undesirable and accompanied by guilt feelings. Another compromise mechanism is *reaction formation*, by which the individual develops conscious attitudes that directly oppose repressed thoughts and desires. In *projection*, he convinces himself that others have toward him the very thoughts and feelings he has repressed. *Compensation* is an attempt to disguise or hide an undesirable trait by emphasizing a desirable one. It ceases to be of value if it gets out of control and becomes *overcompensation*. Three basic mechanisms of compromise through *intellectualization* are *rationalization*, finding false reasons for unacceptable behavior; *isolation*, separation of conflicting attitudes into "logic-tight" comments; and *undoing*, ritualistic cleansing behavior. Sometimes individuals in a weak position attempt to destroy a threat to their self-esteem by *identification with the aggressor*.

The difference between normality and abnormality is one of degree only, but it is usual to classify behavior as abnormal when the individual's defensive reactions become exaggerated and disorganized so that they hinder rather

than help. Abnormal reaction patterns are classified either as *neuroses* (disturbances that may be either mildly or seriously incapacitating but seldom require hospitalization) or as *psychoses* (very severe disturbances characterized by partial or complete loss of contact with reality).

Typically, neurotic disorders are based primarily upon anxiety—generalized feelings of worry and apprehension. Specific symptoms vary a great deal in kind and severity. Typical neurotic reactions include *phobias*, which are irrational fears; *obsessions* (persistent irrational thoughts) and *compulsions* (bizarre actions, usually symbolic or ritualistic in character); and *dissociative reactions*, which may take the form of *amnesia* (loss of memory), *fugue* (loss of memory accompanied by physical flight), or *multiple personality* (the alternation of two or more separate “personalities”).

A neurotic reaction less common today than formerly is *conversion reaction* (hysteria) in which anxiety is converted into physical symptoms which have no organic basis. Closely related to hysteria but less severe is *asthenic reaction*, in which the patient suffers constant weariness and mild unpleasant sensations such as palpitation of the heart. Extreme preoccupation with bodily activities and health, known as *hypochondria*, is another frequent form of neurosis, as is the *neurotic depressive reaction*, in which the significance of frustrations is overestimated.

Psychotic reactions are usually characterized by bizarre and sometimes violent symptoms but not by the anxiety found in neurotic disorders, since psychotic individuals have to a greater or lesser degree lost contact with reality. *Insanity*, a legal concept applied to any mental condition that renders the individual incapable of knowing right from wrong, may include severe neuroses as well as psychoses. *Organic psychoses* are related to neural damage caused by injury or illness. *Functional psychoses*, on the other hand, are apparently precipitated primarily by psychological stress. They are classified as *schizophrenic*, *paranoid*, *affective*, and *involutional psychotic*.

The most common symptoms of psychotic behavior, occurring either singly or in combi-

nation, are *delusions* (strong beliefs opposed to reality—such as delusions of *grandeur*, of *reference*, or of *persecution*); *hallucinations* (sensory impressions of external objects in the absence of an appropriate stimulus); and *emotional distortion*. The latter may be characterized by alternate exaggerations and blunting of emotional responsiveness. In the schizophrenic reaction known as *catatonia* the patient suffers extreme stupor or apathy, remaining motionless for hours. In *manic-depressive* psychoses the patient may alternate between extreme elation and deep gloom.

Studies indicate that heredity may play a part in the development of functional psychoses, probably through the inheritance of a *predisposition* to the psychosis, which appears only under conditions of extreme frustration. Recent experiments have also indicated that differences in body chemistry play a part, but the relationship between cause and effect has not yet been established. The drugs *mescaline* and *lysergic acid diethylamide* (LSD) produce temporary symptoms of mental illness in healthy persons and, while they are useful in research, are dangerous in the hands of amateurs. Environmental factors such as parental rejection or overprotection, faulty discipline, or extreme insecurity can also predispose an individual to mental illness in adulthood.

Only recently has experimental analysis of abnormal behavior in human beings been attempted. A technique (based upon operant conditioning methods) which makes use of a machine similar to a candy dispenser has shown promise as a method of measuring the severity of psychoses and also of determining the effectiveness of drugs used in treatment.

Alcoholism, *drug addiction*, and *compulsive gambling* are also used as means of escape from the frustrations of life. Although the first two involve some physiological factors, all three are usually rooted in emotional problems which can be solved most effectively by psychotherapy. Alcoholics Anonymous, Gamblers Anonymous, and Synanon, a therapeutic community which uses similar techniques with drug addicts, are effective in bringing about rehabilitation in many cases.

Chapter 14 Outline

THE MENTAL HEALTH CARE SYSTEM

CHANGING ATTITUDES TOWARD MENTAL ILLNESS
PROPHYLAXIS
RECOGNITION OF PSYCHOTHERAPY

MAJOR APPROACHES TO THERAPY

DIRECTIVE COUNSELING
CLIENT-CENTERED THERAPY
PSYCHOANALYTIC THERAPY
EXISTENTIAL PSYCHOTHERAPY
ACTION (BEHAVIOR) THERAPY
INTEGRITY THERAPY
BRIEFER FORMS OF PSYCHOTHERAPY
SPECIAL TECHNIQUES IN THERAPY
COMMON CHARACTERISTICS OF DIFFERENT METHODS
EVALUATING PSYCHOTHERAPY

PHYSICAL DISTURBANCES AND THERAPY

SHOCK THERAPY
NARCOSIS
CHEMOTHERAPY
NUTRITION IN THERAPY
PSYCHOSURGERY

THE CLINICAL APPLICATIONS

INSTITUTIONAL CARE
SOCIO THERAPY
TRENDS AND PROSPECTS

Chapter 14 Mental Health and Therapy

During most of its history medical science has been chiefly concerned with conquering the physical diseases that cripple and kill. As these efforts meet with increasing success, attention is turning more and more to the emotional disorders which also can severely handicap a physically healthy person.

Until recently, people had little understanding of the causes of mental illness. In the Middle Ages, anything that was not understood was likely to be ascribed to supernatural powers and witchcraft. Philosophical and religious doctrine had for centuries stressed "reason" as the God-given attribute separating man from irrational brutes. Men who behaved irrationally were considered to be no better than animals, and were treated as such (Foucault, 1965). In early asylums such as England's infamous "Bedlam," established around 1400, patients were cruelly confined and beaten and sometimes exhibited to the curious for a fee.

THE MENTAL HEALTH MOVEMENT

The conditions typical of mental hospitals around the turn of this century were described by a former patient, Clifford W. Beers. His hands cruelly restrained, he was cursed and spat upon by untrained attendants. In spite of leg injuries previously sustained, he was jerked roughly from his bed by a doctor who was irritated at not having received an answer to a question.

Such practices were customary for the time, but the patient was unusual. Not only did he recover his health (not in the hospital but in

the home of an attendant who had taken an interest in him), but he undertook a successful crusade to improve the treatment of the mentally ill. Publicizing the story of his own experiences, he urged the adoption of more humane and, at the same time, more effective therapy (Beers, 1908). This was the beginning of the mental health movement in the United States.

Beers' zealous efforts resulted in the establishment of the National Committee for Mental Hygiene in 1909. However, the mental health movement was slow in gaining impetus until World War II, which highlighted the problem of mental breakdowns induced by the stress of military service. Since then, there has been increased concern with the tasks of preventing and treating mental disorders. An important step forward was the passage in 1946 of a National Mental Health Act, under which the National Institute of Mental Health was established. This organization has been concerned primarily with research and training, but it also has given financial and advisory support to mental health services in states and communities.

Under congressional legislation in 1955, an extensive study of the nation's needs and resources for preventing and treating mental illness was undertaken by the Joint Commission on Mental Illness and Health, composed of forty-five psychiatrists, psychologists, sociologists, welfare leaders, and other experts in mental health professions. This study led to a detailed report (1961), which made sweeping recommendations for more efficient use of available resources and personnel, both professional and nonprofessional, for greatly expanded federal aid for both research and encouragement of mental health services of all kinds, and for a basic shift toward handling serious mental illness in relatively small, versatile, community-based

centers. Already these recommendations have led to new congressional action in the Community Mental Health Centers Construction Act of 1963, to be described later in this chapter, and to a reorganization of the National Institute of Mental Health in 1966. Besides new directorships for administering Institute activities in the areas of research, manpower and training, mental health service programs, and field investigations, the new administrative structure provides for four new centers for the study of alcoholism, narcotics and drug abuse, suicide prevention, and metropolitan mental health problems; four other centers to coordinate all Institute and Institute-related activities involved in the study of schizophrenia, mental health and social problems, mental health of children and youth, and crime and delinquency; and two comprehensive community mental health centers to function as models for the development of others throughout the country.

Meanwhile, professional agencies have played an important role in promoting mental hygiene outside of hospitals as well as better care within them. The American Psychiatric Association, for example, has established a Central Inspection Board for mental hospitals and has set standards for minimum personnel ratios in mental hospitals for physicians, psychologists, and other personnel. Local, state, and national voluntary mental health associations, though not as a rule operating facilities for treatment of patients, provide other necessary services and disseminate information about mental health.

Changing Attitudes Toward Mental Illness

During the past fifty years much has been done to improve treatment of the mentally ill and to educate the public to accept a humane and scientific attitude toward mental illness. There is a wide contrast between early methods of treatment and the modern methods we shall discuss in this chapter. ■

In the field of public education the mental health movement has made marked progress. In one study a majority of those questioned in a small midwestern city indicated they would consult a psychiatrist or a psychologist in case

of actual or suspected mental illness in themselves or in their family (Nunnally, 1961).

Other studies have shown, however, that much still remains to be done to educate the public in regard to mental health.

In a study involving 140 male college students, 92 per cent indicated a favorable attitude toward counseling. Apparently this favorable attitude was on an intellectual level only, however, for 56 per cent stated that they would hesitate to go to a psychiatrist with their personal problems. When presented with hypothetical problems and asked what they would do if faced with such a problem, only 11 per cent indicated that they would go to see a psychiatrist about problems of a psychological nature such as extreme depression. Only 30 per cent of the students involved were aware that a psychiatrist was available at their college (Watts and Davis, 1960).

In a study conducted in Salt Lake City, all families in eight randomly selected city blocks—representative of a cross section of the city population—were interviewed by a psychiatrist and a psychiatric social worker. Of the 609 adult members of the families involved, 111 were found to be suffering from some form of mental illness. Of those interviewed, the only ones listed as mentally ill were obvious cases, such as that of a man who stated that half of his body was pure electricity. Only 11.6 per cent of the cases were receiving psychiatric care (Cole, Branch, and Shaw, 1957).

The public also needs further information regarding the differing roles of psychiatrists and psychologists.

A study of 143 evening division undergraduates in nonpsychology adult education courses revealed an encouragingly large amount of insight into the general nature of psychology and psychiatry. However, there was inadequate knowledge of the training required of the two types of practitioners and some inaccuracy in knowledge of functions. For example, only one third of the subjects realized that a psychiatrist performs physical examinations and many believed wrongly that he uses more psychological tests than does the psychologist (Tallent and Reiss, 1959).

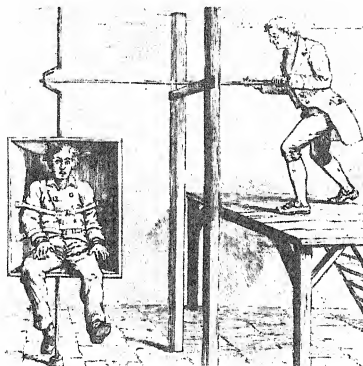
Prophylaxis

Mental health workers have also created public awareness of the importance of psychologi-

cal *prophylaxis* in preventing mental disorder. With mental health, as with physical health, this term refers to the use of precautionary methods to prevent disease. Such prophylactic measures as pure food and drug laws, the establishment of sanitary living conditions, and the use of immunization scrums have made the standard of physical health in the United States far superior to that in most other countries. Yet most Americans are still comparatively unaware of existing facilities for safeguarding their mental health.

Clues from epidemiology. A number of physical diseases have been brought under control

only after their causes were discovered through *epidemiology*, the study of the incidence, distribution, and control of diseases. Likewise, epidemiological studies are bringing to light many of the causal factors in mental disorders. In a study made in Chicago over thirty years ago, for example, it was found that schizophrenia and *anomie* (loss of the sense of personal identity) were most prevalent among persons living in socioeconomically depressed areas of the city where there was a high migratory rate. More intensive studies conducted after World War II confirmed the finding that low socioeconomic status is an important factor in mental illness. It has also been discovered that per-



■ Through the centuries, concepts of mental illness and ways of treating it have often been bizarre by today's standards. For a long time irrational forces or evil spirits were blamed for mental illness and patients were cruelly restrained, regarded as curiosities (often shown to the public for a fee), and submitted to various kinds of violent treatment in an effort to shake the individual back to his senses or make his body such an uncomfortable place that the evil spirit would leave it. As late as 1818, well-regulated institutions were expected to have devices like this circulating swing (left), which was supposed to cure depression. Unfortunately, even after mental illness was recognized as a phenomenon with natural causes and the need for humane treatment was accepted, the experience of patients in mental institutions was far from ideal. Too often they have faced neglect, boredom, and loneliness in huge state hospitals too overcrowded and understaffed to give them anything but custodial care, as shown in the photograph, taken in a state mental hospital in the late 1940's (right). Today the push is toward smaller mental hospitals and separate facilities for acute and chronic patients.

sons of low socioeconomic status who live in one-family dwellings have a lower rate of psychosis than do those of similar status who live in multiple-family dwellings (Gruenberg, 1954).

A British epidemiological study was concerned with the effects of social planning on the incidence of mental illness.

A detailed survey of mental health was made in New Town, one of the planned communities built to relieve population pressure on large English cities after World War II. Admission rates for mental hospitals and referrals to psychiatric outpatient clinics were significantly below national averages. However, the proportion of neurotic admissions was twice the national average, and twice as many women as men were included. No relation was found between mental illness and social class or length of stay in the planned community. The investigator concluded that while this type of social planning increased the occurrence of some types of neuroses, it seemed to decrease the number of psychoses and neuroses due to acute environmental stress (Taylor and Chave, 1964).

Several epidemiological studies have dealt with specific cultural groups.

One team of investigators has made an exhaustive report on the Hutterites, an isolated Middle Western religious sect who live a simple, rural life, providing every member with economic security but foregoing all luxuries, such as radios, jewelry, and even overstuffed chairs. All property is held in common, and community life is highly social in nature; the Hutterites not only work together but even eat in a community dining room.

Schizophrenia was very seldom found among these people, although elsewhere it is the most common psychosis. On the other hand, manic-depressive psychosis was much more common than among the general population (Eaton and Weil, 1955).

This finding is in line with other statistics showing that manic-depressives are more often found among religious or professional persons, who feel a strong need to live up to social expectations, whereas schizophrenics are more likely to have been rather isolated socially.

In another study of cultural patterns in relation to mental health, thirty young male schizophrenics of Irish

background were compared with thirty of Italian background. Such factors as age, education, and economic status were equated. It was found that the Irish patients tended to be quiet and compliant but tormented by guilty feelings about sex. Usually their homosexual tendencies (characteristic of most schizophrenics) were latent or repressed, whereas a majority of the Italians had become overt homosexuals. Furthermore, the Italian patients were difficult to manage, twenty-three of them having a history of assaults, destruction of property, and so on. They expressed their feelings violently, instead of taking refuge in fixed delusions and fantasies as the Irish patients did.

This contrast in symptoms is directly related to the contrast in Irish and Italian home life. In the Irish home, the mother is the dominant figure and tends to treat her sons as boys, even after they are grown. Furthermore, sexual feelings are frowned upon as sinful, and active expression of emotions is taboo. In the Italian home, on the other hand, the father dominates the family. Emotions are freely expressed and little guilt is attached to sex (Opler, 1957).

As further epidemiological studies tell us more about the physical and cultural variables consistently related to given abnormal patterns, it is hoped that we will be able to reduce the incidence of mental disorders through environmental change.

Good parent-child relationships. As we saw in the preceding chapter, healthy emotional life during infancy and childhood is extremely important in the development of satisfactory adjustment patterns in later life. Indeed, it is now generally recognized that the most important of all factors in preventing mental illness is emotional security, which has its roots in healthy parent-child relations. Although it is difficult to lay down specific rules for rearing children, psychologists are generally agreed on the value of the following principles:

"(a) an uninterrupted relation with a responsive, empathetic mother or her substitute, (b) flexibility in feeding schedules, toilet training, and lessons in social living, (c) freedom commensurate with maturity such that necessary limits are set on behavior but undue restrictions are not placed on reality testing, (d) consistent guidance and support, including desirable adult models for the child and extra support during crucial periods,

and (e) most important, a loving atmosphere in which the child is respected as an individual and made to feel that he is an important member of the group but no more important than others." (Coleman, 1964, p. 614)

Parents need not fear "spoiling" the child by too much love and attention. A recent study of mother-child relationships in thirty-one cases seen at a child guidance clinic revealed that it is not "nurturance"—the warm, sympathetic, helpful factor in mothering—which produces a dependent, demanding child lacking in consideration for the rights of others. Instead, two other factors are primarily responsible for producing a spoiled child. One is lack of firmness; the other is overprotection, or encouragement of dependency (Finney, 1961). The mother who, consciously or unconsciously, shows that she likes to have the child dependent upon her will usually make him so. The wise mother, on the other hand, rewards and encourages self-reliant behavior.

Healthy parent-child relationships will go far toward producing a well-adjusted child who will, in turn, develop into a well-adjusted adult.

Adjustive behavior in everyday life. Not all prophylaxis takes place during childhood. The following are principles of good adjustment which may be deliberately cultivated at any age:

1. Knowing which elements in the external situation can be changed to fit your needs better and accepting without resentment those which cannot be changed.

2. Improving your competence to handle situations; acquiring social and conversational skills if you feel ill at ease in social situations, or developing vocational competence if you feel insecure in your job.

3. Acknowledging and accepting your emotions. Wartime studies showed that admitting fear when in serious danger helps keep that fear from becoming intolerable. Much mental illness seems to grow out of the patient's inability to accept as part of himself the sexual desires or hostilities or other feelings that he has learned to regard as degrading or morally wrong.

4. Keeping busy in constructive work which you feel is valuable.

5. Cultivating a sense of humor, especially about yourself.

6. Sharing in social activities and responsibilities.

7. Reinterpreting situations. Often our frustrations are the product not of anything in the external situation but of faulty evaluations on our part. Our self-pictures, too, are often distorted. Reevaluation in the light of reality may be very difficult and may even require the help of a friendly outsider, such as a minister or teacher trained in counseling techniques, or a clinical psychologist or psychiatrist.

8. Developing sensitivity to the way others react to you, thus establishing a basis for monitoring and modifying your behavior toward them.

Growth of guidance facilities. From the standpoint of prophylaxis, perhaps the most effective achievement of the mental health movement is the phenomenal growth of psychological clinics and guidance centers during the past few decades. Assisted in many cases by federal aid, state and community mental health agencies are now widespread throughout the country. Using teams made up of psychiatrists, psychologists, and social workers, such agencies offer services and aid to people with problems in child guidance, marital adjustment, vocational adjustment, and other personal matters. In some cities special recreational facilities and guidance centers are now being provided for handling the unique adjustment problems of older people.

In Los Angeles, an emergency center organized by the clinical psychologists of the area offers around-the-clock aid in response to telephone calls. Within hours after calling, an individual may see a psychologist in his own vicinity, with a maximum of six hour-long visits available. In practice, most patients have been able to overcome the worst of their difficulties in four sessions or less when in the grip of a crisis, with competent help readily available. A person so depressed that he is ready to take his own life may be saved by a program of this kind, whereas if he had to take his place at the end of a long waiting list at a regular clinic, his turn might come too late. This center was started by the contributions of psychologists, who still donate their time, although fees based on ability to pay defray most of the office expenses.

In spite of the rapid increase in guidance and clinical facilities, the supply still falls far short of the demand. One survey in which 2460 American adults were interviewed revealed that one in seven had sought professional help with his problems, while one in four had had problems for which he felt professional help would have been valuable (Gurin, Veroff, and Feld, 1960). In 1965 there were in the United States about 2000 outpatient clinics. Many of these operated only on a part-time basis, and most had long waiting lists. The number of clinical facilities must be *at least doubled* before it will be adequate to meet present needs (National Association for Mental Health, 1966).

The Community Mental Health Centers Act passed in 1963 provides for the development of comprehensive community mental health centers throughout the country. This program is aimed at guaranteeing prompt attention to the mental health problems of all age groups whenever it is needed and without removing the patient from the community in which he lives. The services offered by centers established under this act are outlined below; to qualify for a federal grant an agency must, alone or in conjunction with others, provide at least the first five of these services.

1. *Inpatient services.* Treatment for patients requiring full-time hospitalization.

2. *Outpatient services.* Various kinds of individual and group treatment programs for children, adults, and families, without a waiting period.

3. *Partial hospitalization.* Day care and treatment for patients able to return to their homes for the night; night care for those able to work or attend school during the day.

4. *Emergency services.* Service available within at least one of the above institutions twenty-four hours a day, with arrangements for appropriate care thereafter.

5. *Education and consultation.* Members of the staff available for consultation with community agencies and professional personnel.

6. *Diagnostic services.* Extensive examination and screening of patients.

7. *Rehabilitative services.* Vocational, social, and educational programs for former hospital patients and others.

8. *Precare and aftercare services.* Foster homes and halfway houses; home visitation.

9. *Training.* Training programs for all types of mental health personnel.

10. *Research and evaluation.* Programs of research on mental health or cooperation with agencies carrying out such research (U. S. Public Health Service, 1964, 1965).

Several of these important services are illustrated on page 538. As more of the new comprehensive centers are built and more personnel trained, it is anticipated that all ten of the services listed will be made generally available. According to expert analysis, one of these comprehensive community centers will need to be planned for every 50,000 people in the population at large if adequate help is to be provided.

Recognition of Psychotherapy

Psychotherapy, which literally means "mental treatment," is a term applied to the treatment of personality and behavior disorders by psychological methods of therapy—in contrast to physical methods such as drugs and surgery. Psychotherapy is as old as recorded history. It is referred to in the Old Testament and in the writings of the ancient Greek philosophers. Among the ancients, psychotherapy was relegated to the priests, who employed magic, incantations, music, and other techniques designed to drive out the evil spirits which they believed to be the cause of mental illness. Mental healing is certainly not a twentieth-century innovation, but the development of modern psychological techniques has established psychotherapy firmly among the healing arts.

Goals of modern psychotherapy. The fundamental objective of all psychotherapy, regardless of the specific techniques employed, is to help the individual improve his *modes of response* to real-life situations. To accomplish this end, psychotherapy does much more than give the client intellectual insight into his personality problems. It tries to help him improve his emotional responses, his ways of handling difficulties, and his ability to meet his fundamental needs.

Practitioners of psychotherapy. Psychotherapy is a broad field that calls upon a variety of professional services. Among the general public, some confusion still exists as to the functions and legal status of the various kinds of practitioners who treat mental disorders. Here we shall consider the psychiatrist, the neurologist, the clinical psychologist, the psychoanalyst, and the psychiatric social worker.

The *psychiatrist* is a physician who has completed his medical training and done graduate work and resident training in psychiatry. The law provides penalties for the untrained person who calls himself a psychiatrist. The psychiatrist may legally give medicines, prescribe diets, use surgery, and administer electroconvulsive shock therapy. He may also practice psychoanalysis or any other method of psychotherapy. In England he is often called a psychologist.

The *neurologist* also is medically trained. He specializes in the treatment of mental abnormalities which have their basic origin in unhealthy body tissue, usually in the brain and nervous system. He uses surgery, diet, drugs, exercises, electroconvulsive shock, and other physical treatments. Frequently a physician practices both neurology and psychiatry; he then may be called a *neuropsychiatrist*.

The *clinical psychologist* practices psychotherapy and, in a hospital or group setting, is typically in charge of diagnostic testing. His duties were described in some detail in Chapter 1. In most states, the clinical psychologist does not have legal status or protection by law. However, ethics demand that the nonmedical psychologist who practices psychotherapy, whether for a fee or not, must have training and supervised experience comparable to that required of the medical practitioner. This usually means having a Ph.D. degree from an accredited university, plus a year of supervised practice. In many states there is no law governing the use of the word *psychologist*; thus untrained persons can advertise themselves as psychologists.

The *psychoanalyst* has a particular system of theory and practice which distinguishes him from other clinical psychologists and psychiatrists. Theoretically, any person who chooses to practice psychoanalysis may do so, because the law does not define his status and training.

The organized psychoanalysts in this country, however, now require the practitioner to possess an M.D. degree—even though Sigmund Freud, the originator and acknowledged leader of the psychoanalytic movement, argued that some of the most valuable contributions to the development of psychoanalysis had come from men without medical training. Today many nonmedical workers are making quite extensive use of the concepts and techniques of psychoanalysis, even though they are not thoroughgoing psychoanalysts in either theory or practice.

The *psychiatric social worker* is a specialist in one particular area of social work. His special training consists of two years of postgraduate study, leading to the degree Master of Social Work. The psychiatric social worker studies the social realities of the patient's situation: his interpersonal relationships, especially with family members, and the socioeconomic and cultural factors that affect the family as a unit. This information about the patient helps the psychiatrist or clinical psychologist to make an accurate diagnosis. In addition to supplying this data, the psychiatric social worker contributes to treatment by helping the patient and his family with problems related to the central one, such as obstacles to the acceptance of psychiatric care or problems of social relationships. Trends toward preventive work, a positive program for mental health, and the growing number of people seeking mental health services are causing some psychiatric social workers to move into nonmedical settings such as public education and counseling services.

The problem of privileged communication. The practice of psychotherapy is occasionally complicated by the fact that the patient may reveal legal guilt in connection with some punishable crime. Anyone except a husband or wife who acquires such information is responsible for reporting it to the authorities unless he enjoys *privileged communication*—the right not to disclose information received in a professional capacity. This privilege is at present granted in common law to all lawyers. Not all states grant privileged communication to physicians, however, nor is it enjoyed by medical officers in the armed services, who must report to their

superiors for purposes of disciplinary action. Clinical psychologists are working toward the legal right of privileged communication and as of 1966 had achieved it in Alabama, Arizona, Arkansas, California, Colorado, Delaware, Florida, Georgia, Idaho, Illinois, Kentucky,

Louisiana, Michigan, Mississippi, Nevada, New Hampshire, New Jersey, New Mexico, New York, Oklahoma, Oregon, Tennessee, Utah, Virginia, Washington, and Wyoming. Under California law, psychologists have greater protection than do physicians in private practice.

MAJOR APPROACHES TO PSYCHOTHERAPY

The types of psychotherapy being practiced today are many. Therapy varies with the nature of the individual case and with the personality, educational background, and convictions of the therapist. In some cases the differences are of method only; in others they represent basic differences in personality theory and correspondingly different beliefs about the proper function of therapy. For example, some therapists believe that they should give complete direction to the patient; others center responsibility entirely in the patient. Such variations clearly reflect basically different theories about human personality and how it changes.

It should be remembered, however, that all techniques of therapy are directed toward the same ultimate goal—helping the individual make a more satisfactory adjustment to his problems. In spite of the differences, each method has much in common with one or more of the others.

Most types of psychotherapy employ, to varying extents, the principle of *catharsis*, or the discharging of emotional tension by “talking out” or otherwise expressing one’s frustrations. Because most of the problems that worry people involve ideas and experiences which are psychologically painful, catharsis is usually a slow process. Early sessions with the therapist are likely to seem unproductive. When the patient is instructed to talk about what worries him, he will usually stick to the superficial aspects of his problem at first. In succeeding sessions, however, he will become more and more frank, search more and more deeply into his own problem, and eventually tell of experiences and

emotions which have long been concealed from himself as well as from others.

Directive Counseling

Directive counseling is the simplest and most limited type of psychotherapy. Here the therapist supplies direct answers to problems which are consciously worrying the client. Directive counseling is practiced by teachers, ministers, physicians, social workers, lawyers, employment interviewers, and parents and friends, as well as by counselors connected with guidance clinics. It may involve reassurance, suggestion, interpretation, and questioning, as well as the giving of information.

Counseling of this kind has many values, especially in offering quick solutions to many types of relatively minor problems. In cases which call for more than advice and encouragement, however, it has limitations. It may even be harmful if it encourages the individual to rely on others for the solution to his problems or if it prevents or delays treatment of serious emotional disturbances.

Client-Centered Therapy

A completely *nondirective* technique is that of client-centered therapy, developed largely by Carl Rogers, whose theory of personality was discussed in Chapter 4 (Rogers, 1951). Nondirective therapy is based on the premise that an

individual who is sufficiently motivated can work through his own problem if he can become free enough from self-deception and fear to recognize that problem for what it is. Accordingly, he is encouraged in a face-to-face interview to talk freely about anything that troubles him and to approach it in any way he likes. The therapist neither praises nor blames but accepts whatever is said, perhaps rephrasing it or helping the individual to clarify his own reactions.

The theory of nondirective therapy is that by "talking it out" in a permissive atmosphere, the client will himself come to see certain relationships between his feelings and his behavior. Therapy is regarded as a "growth process" in which the patient utilizes his own potentialities to achieve a more mature level of emotional adjustment. From the beginning, the client is responsible for his own behavior and his own decisions, as well as for the course of therapy. The idea that "the doctor knows best," is missing from this form of therapy. Superficially the role of the therapist is that of "reflecting" back to the client the feelings he has expressed. Actually, however, the therapist's attitude of acceptance and concern is probably of greatest significance, for it helps the client develop the self-confidence and strength to handle his difficult problems of adjustment.

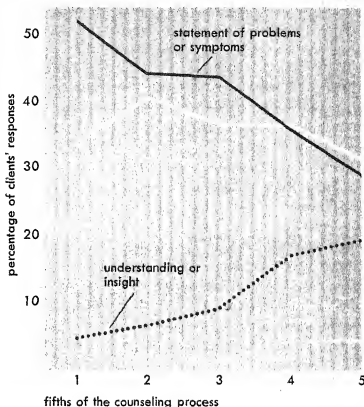
The following case illustrates the nature of nondirective therapy and also the gradual change from negative feelings to positive ones which is characteristic.

Mary Jane Tilden, age twenty, was brought to the counselor by her mother. She seemed to be retreating from life, spending the major portion of her days sleeping, listening to the radio, or brooding. She had given up her job and all social contacts; she rarely bothered even to dress. Her first interview was completely negative except that she did decide to return for further treatment.

Miss T.: "... It's just when I compare myself to the other girls it seems—I don't feel at all up to it ... they seem to be so normal in everything they did and they were unfolding the way everybody should unfold in this world. And when I thought about myself, I thought, 'Well, my gosh! I'm not even coming near it.' And it was just such a blow that—I just started to realize that I wasn't coming along the way I should—I mean I just wasn't progressing."

Counselor: "It wasn't that you were jealous, but that you gradually realized that here they were ready for a new part of their life and you just weren't ready for it." ...

T.: "... I seem to be going backward all the time: In fact, I don't see any reason why I should be living. ... It's very funny, I can see it for everybody else but I can't—I have enough confidence in other people's ability but I can't see it for myself."



Based on Seeman, 1949

CHANGES IN CLIENTS' STATEMENTS DURING NONDIRECTIVE THERAPY

One test of Rogers' theory of growth is provided by comparisons of clients' statements at different stages of psychotherapy. This graph shows the findings of one such comparison, in which the statements of ten clients were classified into four categories and a count made for each fifth of the series of interviews. At the beginning, the patients were preoccupied with their problems and symptoms. During the series such concern dropped markedly, while there was a steady rise in statements indicating self-understanding. There also were signs that patients were beginning to take responsibility for making plans instead of depending on the therapist to solve their problems for them and tell them what to do.

C.: "You can understand why other people would want to live but for yourself you see very little reason." . . .

T.: " . . . There's one thing I can't quite make up my mind—I've tried to figure it out—well, what is it, when I get into a rut like this, what is it that I really want? And when I examine myself I can't figure out what I really want. It's only by looking at what other people want that I think, well, maybe that's what I want. It's a very odd thing, and I don't like it. That's what makes me feel—that it's a—that I can't do what I want to do because I don't really know what I want."

C.: "You feel that, so far, the best you have been able to achieve along that line is just to take a goal that seems to be good for somebody else. But that you don't feel that there's any real gain that you are sure you want." . . .

During the fifth interview Miss Tilden discussed her first tentative steps toward improving her situation, but with many reservations. By the eighth interview, she was beginning to look at her behavior more objectively.

T.: " . . . When you're in a family where your brother has gone to college and everybody has a good mind, I wonder if it is right to see that I am as I am and I can't achieve such things. I've always tried to be what others thought I should be, but now I'm wondering whether I shouldn't just see that I am what I am."

C.: "You feel that in the past you lived by others' standards and you are not sure just what is the right thing to do, but you're beginning to feel that the best thing for you is simply to accept yourself as you are." . . .

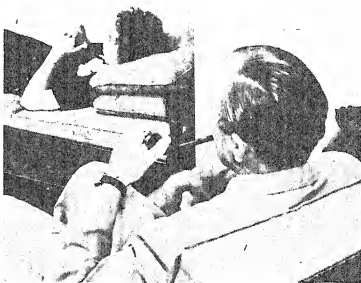
T.: "Well, I guess that is so. I don't see what it is that has changed me so much. Yes, I do. These talks have helped a lot, and then the books that I've read. Well, I've just noticed such a difference. I find that when I feel things, even when I feel hate, I don't care. I don't mind. I feel more free somehow. I don't feel guilty about things." (Rogers, 1947)

In the course of therapy, the client made considerable progress in working out for herself a new understanding and acceptance of herself and hence a more satisfactory adjustment to life. This did not come suddenly and there were setbacks, but the overall progress was unmistakable. Note that the counselor did not at any time force the issue, nor did he introduce any new ideas, give her advice, or employ reassurance or moral exhortation. What he tried to do was to reflect and clarify the client's own feelings and attitudes in such a way that she could better understand herself.

Psychoanalytic Therapy

Psychoanalytic therapy is an intensive and prolonged technique for exploring the patient's unconscious motivation, with special importance attached to the earliest sources of conflict and repression. Its aim is to bring to consciousness such repressed memories and conflicts and to help the individual resolve them in the light of adult reality. Such a process presumably effects a radical change in the individual's basic personality structure. Psychoanalysts use several techniques for bringing repressed conflicts to consciousness and helping the patient to solve them. These include free association, dream analysis, analysis of resistances, and analysis of transference.

Free association. The principal procedure used in psychoanalysis to probe the unconscious and release repressed material is free association. The patient sits comfortably in a chair or lies in a relaxed position on a couch and lets his mind wander freely, giving a running account of his thoughts, wishes, physical sensa-



▲ A typical psychoanalytic therapy session. The therapist sits so that his client cannot see him as she lies in a relaxed position and tells him whatever comes to mind.

tions, and mental images as they occur. He is encouraged to reveal his every thought, regardless of how personal, painful, or seemingly unimportant. The therapist often takes a position behind the patient, where he will not serve as a distraction or disrupt the flow of association. ▲

Although considerable catharsis is achieved in this "talking out" process, psychoanalysis is not fundamentally a client-centered technique. Rather, emphasis is placed on the authority of the therapist, who interprets to the patient the meaning of the thoughts, wishes, and attitudes expressed in the free association. As the stream of consciousness reaches deeper and deeper into the unconscious, the repressed urges which are uncovered often reveal themselves in disguised symbolic form. The analyst uses his training and experience to remove the disguises from the subject's revelations and thus explain their real significance.

Dream analysis. Psychoanalytic therapists can gain further insight into the patient's unconscious motivation by the technique of dream analysis. When the individual is asleep, his ego is presumably less on guard against the unacceptable impulses originating in the id, so that a motive which cannot be expressed in waking life may find expression in a dream. Some motives are so unacceptable to the conscious self, however, that they cannot be revealed openly even in dreams but must be expressed in disguised or symbolic form. Thus a dream has two parts, or contents. The *manifest* (openly visible) content of the dream is that which we remember and report upon awakening. It usually is not painful and, in fact, often seems quite amusing. Beneath the manifest content is the *latent* (hidden) content—the actual motives which are seeking expression but which are so painful or unacceptable to us that we do not want to recognize their existence. A trained therapist can often uncover these hidden motives by studying the symbols which appear in the manifest content of the dream and finding out what particular meaning they have for the dreamer.

The unconscious process which transforms the emotionally painful latent content of the dream into the less painful manifest content is called *dream work*. Dream work distorts the

content of a dream in various ways, making the motives expressed in it less obvious to the dreamer. For example, a student who is filled with anxiety about failing an examination and being expelled from school may express his fear symbolically by dreaming that he is pushing his way through a heavy snowstorm, pursued by wild animals. Or, with rather less disguise, a woman who feels hostility toward her husband might dream of killing a rat—the significance of this symbol being revealed by her often referring to her husband as "the little rat."

Free association, with the manifest content of the dream as the point of departure, gives the analyst clues as to the latent content and enables him to interpret the real meaning to the patient. Skilled therapists who are familiar with the kinds of distortion created by dream work are frequently able to locate a conflict of which the patient is not aware.

Analysis of resistances. During the process of free association, the patient may show resistances—that is, inability or unwillingness to discuss certain ideas, desires, or experiences. Resistances prevent the return to consciousness of repressed material which is painful to recall, such as material connected with the individual's sexual life or with hostile, resentful feelings toward his parents. Sometimes a resistance is shown by the patient's coming late to his appointment or "forgetting" it altogether.

The psychoanalyst of the Freudian school attaches particular importance to subjects which the patient does not wish to discuss, believing that they are most closely related to the repressed experiences that are presumably causing the present difficulties. The aim of psychoanalysis is to break down resistances and bring the patient to face these painful ideas, desires, and experiences. Breaking down resistances is a long and difficult process but is considered absolutely essential in order to bring the whole problem into consciousness where it can be solved.

Analysis of transference. During the course of psychoanalytic treatment, the patient usually develops an emotional reaction toward the therapist, identifying him with some person who has been at the center of an emotional conflict

in the past. This phase of therapy is known as transference. In most cases the analyst is identified with a parent or lover. The transference is called *positive transference* when the feelings attached to the therapist are those of love or admiration and *negative transference* when they consist of hostility or envy. Often the patient's attitude is *ambivalent*—that is, he experiences both positive and negative feelings toward the therapist, as children often do toward their parents.

The analyst's task in handling the transference is a difficult and dangerous one because of the patient's emotional vulnerability, but it is a crucial part of treatment. The therapist helps the patient to interpret the transferred feelings and to understand their source in earlier experiences and attitudes.

Criticisms of psychoanalytic therapy. In Chapter 4 we saw how the neo-Freudian psychoanalysts differed from Freud in their theories of personality—primarily in placing relatively more emphasis on current environment and less on childhood experiences. The same difference in emphasis appears in neo-Freudian therapy, which is aimed at understanding the patient's present situation as well as his past experiences. Also, most neo-Freudian psychotherapists believe that a cure cannot be effected simply by helping the patient understand his unconscious feelings but rather that the patient must be *directed* along the path of changing himself and his inadequate modes of adjustment.

From a practical standpoint, psychoanalysis has also been criticized on the grounds that it requires a great deal of the patient's time and money. Psychoanalysis aims to create a fundamental and permanent alteration in the individual's personality structure, a goal that usually requires at least two or three years of frequent sessions with the analyst. This period of time does not seem inordinately long, however, when we consider that the patient's problems may have been building up for most of a lifetime.

Even when the individual can afford to spend the time and money necessary for a complete course of analytic treatment, the results are not always satisfactory. Because psychoanalysis re-

lies heavily upon the patient's achieving great personal insight, it is best adapted to individuals who are above average in intelligence and who do not have severe mental illness. The following reasons have been cited as the primary causes of failures in psychoanalytic treatment: (1) the analyst's difficulty in applying psychoanalytic techniques because of his lack of ability or training, (2) environmental conditions which interfere with the patient's attempts to readjust, and (3) application of psychoanalytic techniques in cases which are too severe to be handled by this method alone (Oberndorf, 1950).

Existential Psychotherapy

The form of psychotherapy known as *existential psychotherapy* is not a closely knit school of thought but was begun simultaneously and independently by a number of Europeans who were dissatisfied with orthodox psychoanalysis (May, 1958). Realizing that the most common problem of modern man was a feeling of alienation from his world, a loss of the sense of identity or belonging, these psychiatrists felt that psychoanalysis often tended to increase the problem by fragmenting men still further. These dissatisfied psychiatrists and psychologists turned to existentialism in their attempt to overcome the mind-body dualism (see p. 5) and to study man's existence or being.

As we saw in Chapter 4, the existentialist theory of personality emphasizes the importance of individual choices. In the grim but resolute struggle which is life, man's freedom is held to be absolute and it is his own choices which determine what he shall be. Therefore, the existential therapist seeks to find what original or basic choice has led to the maladjusted behavior of his client (Muuss, 1956).

One school of existential analysis, called *logotherapy*, focuses upon the need of the individual to see meaning in his life. The "will-to-meaning" is regarded as the most human phenomenon of all, since animals do not worry about the meaning of life. This school emphasizes Nietzsche's statement, "He who knows a Why of living surmounts almost every How." The human being finds the "Why" through

self-realization, which involves both freedom to choose a course of action and responsibility to choose in such a way as to further spiritual values. Thus logotherapy lays particular stress upon the development of spiritual and ethical values (Weisskopf-Joelson, 1955).

The existential analyst tends to vary his technique from patient to patient, believing that a flexible approach is necessary. Consequently the process of existential psychotherapy is less clearly defined than are some other forms of therapy.

Action (Behavior) Therapy

Psychoanalysis and the other forms of psychotherapy we have been discussing place great emphasis on the patient's gaining insight into his deepest feelings and motivations. Even non-directive therapy focuses upon the client's feelings and strives to help him understand them better. All such forms of therapy may therefore be classed as *insight therapies*. In contrast, *action therapies*, which appear to be gaining in support, deal much more directly with disturbed behavior (London, 1964). Perhaps the difference between the two approaches shows up most clearly in the way symptoms are handled. Symptoms, after all, are what bother the patient and cause him to go to a therapist in the first place. The insight therapist usually turns his attention first to seeking the patient's underlying problem. The action therapist, on the other hand, tries to eliminate the symptom so that the patient will no longer be troubled, whether he understands what happened or not. The insight therapist seeks to reshape the core of his patient's life through guidance and counseling. The action therapist deals with behavior only, not concerning himself with the "self" or the "personality." His goal is "by argument, seduction, threat, or even skillful violence (as a surgeon does), [to] excise the symptom's painful barb" (London, 1964). He exercises much greater control during the actual treatment sessions than does the insight therapist, although frequently the patient is given an opportunity to join in the planning of his program of treatment.

In general, the actionists base their various techniques of psychotherapy upon learning

theory (Harper, 1959). Many of them operate laboratories where they study conditioning in animals and experiment with the production and treatment of neuroses in rats, cats, or monkeys. In recent years, conditioning techniques have been employed increasingly in the treatment of human beings.

The *reciprocal inhibition* technique of action therapy has been used extensively by Joseph Wolpe (1958) and others. Having noticed that neurotic behavior in animals tends to disappear when anxiety-provoking stimuli are presented along with pleasant ones such as food, Wolpe resolved to try the effect of similar combinations of stimuli in treating clients. Instead of appealing to eating responses, however, he uses approach responses or relaxation responses as the pleasant portion of the combination. Through a close study of the patient's personal history and interview data he first works out a list, from weakest to strongest, of the stimuli that provoke anxiety in the patient. If relaxation responses are to be used, the patient is hypnotized and given relaxation suggestions. He is then asked to imagine a situation in which the weakest stimulus on the anxiety hierarchy is present. If relaxation is unimpaired, a stronger anxiety stimulus is imagined, and so on until after a number of sessions the patient can remain relaxed even while contemplating the strongest cause of his anxiety. This specific technique is known as *systematic desensitization*. Wolpe believes that the principle of reciprocal inhibition is responsible for many successful readjustments brought about by other forms of therapy. The positive responses invoked in the patient-therapist relationship combine with, and then inhibit, the patient's anxiety responses.

In one recently reported case a twenty-one-year-old college student, the son of an Army sergeant, had a very severe phobia for Army uniforms and was made miserable by compulsory ROTC training. In addition to experiencing violent reactions, including vomiting and fainting, at drill meetings, he became so preoccupied with his anxiety and his worry about it that he had little time for anything else—in fact, his grades dropped to a "D" average.

Following a diagnostic interview he attended eleven desensitization sessions over a period of seven weeks. He

received training in deep relaxation, and a hierarchy of items of increasing effectiveness in producing anxiety was presented. He completed the last two months of ROTC training with no anxiety, his grades went back up to a "B+" average, and he was even able to visit his parents at their home on an Army base for the first time in two years (Paul, 1964).

Another method of extinction training in current use is the *implosive therapy* of Thomas Stampfl, which in many ways contrasts strongly with the techniques of Wolpe, although it is based on similar learning theory and is also anxiety centered (London, 1964). Stampfl emphasizes the reinforcing aspects of neurotic behavior. That is, he regards neurotic behavior as the conditioned avoidance of stimuli which provoke anxiety. The avoidant behavior reduces the anxiety caused by the stimulus and thus is reinforced. The behavior may itself cause difficulty and in any case the anxiety it reduces is unrealistic because it is aroused by a stimulus which is actually harmless. Nevertheless, as long as it reduces anxiety more than it produces pain or inconvenience, the neurotic avoidant behavior will persist. Moreover, such behavior tends to become generalized to other stimuli so that it is called forth by a whole series of cues, most of which are quite remote from the original anxiety-producing stimulus. As long as the patient avoids all of these things, he continues to believe that his avoidant behavior has saved him from harm. He never gets a chance to learn that he has no real cause for fear. Stampfl arranges things so that the frightening stimulus occurs in circumstances where the patient cannot run away. As this happens again and again, and no harm is forthcoming, the stimulus loses its power to elicit anxiety. When anxiety no longer occurs, the neurotic behavior employed to avoid it disappears. In other words, extinction occurs.

Specifically, Stampfl tries to frighten patients as much as possible for as long as he can at a single session. As in Wolpe's technique, mental imagery is used. The therapist describes as frightening a situation as possible, urging the patient to imagine himself in it. The idea is that when anxiety is extinguished for a very frightening situation the effect will generalize to less frightening ones. If a patient has learned

not to fear lions, he will no longer be afraid of kittens. Imagining extremely frightening situations causes an explosion of panic—or at least that is the therapist's aim. Since this explosion is an inner one, it is called an *implosion*; thus the term *implosive therapy*.

A third form of action therapy makes use of operant conditioning techniques to inhibit or extinguish undesirable behavior and develop new and desirable behavior at the same time. Therapists using this approach try to control the patient's environment in such a way that desirable behavior is rewarded and undesirable responses are extinguished (more often by being ignored than by actually being punished, since punishment sometimes has unpredictable effects). Concrete rewards in the form of food have been used successfully in the treatment of schizophrenics.

Patients were given mild injections of insulin to induce hunger and then were encouraged to solve a graded series of mazes and reasoning problems with fudge as a reward. Such social rewards as praise and approval, used at the same time, gradually became more effective than the physical reward of food, which was eventually discontinued. The final problem in the series was social in nature, involving interpersonal relations, and took the form of a simple psychodrama (see p. 518) on a stated theme. The only reward for this last problem was the praise of the group leader, which was given for effort as well as for final solution. Patients treated by this method showed greater improvement, as measured by behavior in the ward and by occupational therapy ratings, than did a control group (Peters and Jenkins, 1954).

Patients who have been totally mute for many years but are physically capable of speech have been trained to speak by the use of operant techniques (Isaacs, Thomas, and Goldiamond, 1960).

In one study making use of this technique it was found that by reinforcing a patient with pennies or by agreeing to write letters for the patient contingent on speech it was possible gradually to shape what were at first primitive grunts. Further training gradually led to more complete words and finally to sentences. After sixteen training sessions, the patient returned to his ward, and the speech behavior generalized: for the first time in two years he spoke to one of the attendants. When the attendants were also trained in techniques for

reinforcing desired behavior, they were able to participate in the further reestablishment of speech. Eventually the patient was restored to full speech. Although initially his voice was very soft and had a slight lisp, it improved over the years in both volume and quality (Sherman, 1963).

Dramatic success has also been obtained in the application of operant conditioning procedures to the behavior problems of children with psychiatric disorders.

The patient was a three-year-old boy who was hospitalized with a diagnosis of childhood schizophrenia. The child did not eat normally and lacked normal social and verbal behavior. He was given to ungovernable tantrums which included self-destructive behavior such as banging his head, slapping his face, pulling his hair and scratching his face. He had had a cataract operation, and the wearing of glasses was essential for the development of normal vision. He refused to wear them, however, and broke pair after pair. To counteract this problem, the psychologists decided to use the technique of shaping (see p. 188). An attendant worked with the child in his room for two or three twenty-minute sessions each day. The child was first trained to expect a bit of candy or fruit at the clicking sound of a toy noisemaker. The noise of the click soon became a positive reinforcer. The training then began with empty eyeglass frames. The child was reinforced first for picking them up, then for holding them, then for carrying them around. Slowly and by successive approximation, he was reinforced for bringing the frames closer to his eyes. After a few weeks, he was putting the empty frames on his head at odd angles, and finally he was wearing them in the proper manner. With further training the child learned to wear his glasses up to twelve hours a day.

By similar direct applications of operant techniques the child was cured of the temper tantrums which had caused so much apprehension to his family and injury to himself. It was felt that the tantrums might actually have been reinforced by the anxious concern of his parents and attendants—hence the psychologists prescribed extinction as a treatment for the tantrums. The child was placed in his room when a tantrum started; the door was left closed until the tantrum stopped. After this procedure was instituted the tantrums were less frequent; after about five months they stopped altogether, and the child was discharged from the hospital (Wolf, Risley, and Mees, 1964).

Other operant techniques that have been used with schizophrenic children are illustrated on page 516.

Thus far such techniques have been used almost entirely in mental hospitals, where total control of the environment is possible. There appears, however, to be a trend toward greater control of the environment of patients who come to therapists in private practice, at least in the case of children, whose parents are often treated along with them in family group therapy. Operant conditioning techniques may have some potential for use in such therapy.

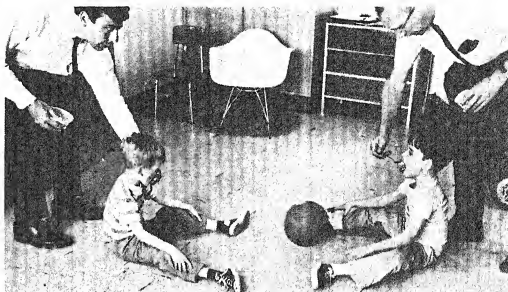
Insight therapists, who regard the symptoms as expressions of an underlying drive that remains in operation, often express the fear that symptoms eliminated through conditioning techniques will simply be replaced by new and equally troublesome ones. This has not proved to be the case in the experience of Wolpe, who presents many statistics in support of his techniques. Other workers have also had good results with the use of systematic desensitization (Ashem, 1963; Lazarus, 1963).

It is perhaps not too optimistic to think of operant conditioning as the greatest advance in therapy of behavior disorders since Freud, as it is effective with types of disorders in which the highly verbal psychoanalytic approach is baffled.

Integrity Therapy

Hobart Mowrer broke away from the Freudian concept over fifteen years ago to found a new school of psychotherapy. He believes that the neurotic patient suffers moral failure, his difficulties arising not from inhibitions but from concealed antisocial actions. Mowrer's method, known as *integrity therapy*, teaches people to take the consequences of what they do instead of blaming their troubles on something done to them by their parents or others. He calls not for new or different moral values, but for greater fidelity to those already accepted but poorly observed. He feels that future treatment of the emotionally ill will take guilt, confession, and expiation seriously.

Mowrer and his associates do not believe that the cause-effect relationship implied by the stimulus-response formula is an adequate expla-



Photos by Allen Grant

Billy was one of four schizophrenic children treated intensively by behavior therapy over a period of several months at the UCLA Neuropsychiatric Institute. At seven, Billy could not talk at all and had been making life a nightmare for his parents with tantrums in which erratic, violent destructiveness alternated with fits of beating his own head against the walls. A series of experts consulted by his distraught parents had diagnosed him as retarded.

At the Institute, treatment was planned on the assumption that the children should be accountable for their behavior and that if they could be induced to behave in normal ways they would be pushed toward normality. The investigator's aim was limited and specific: to suppress pathological behavior and build the beginning of language and intellectual skills. There were daily speech lessons, in which one of the first tasks was to teach children to imitate another's ac-

tions (upper left), a response common among most children but lacking in these withdrawn children. Ten minutes of every hour were given to a play break with generous overt expressions of affection by the staff (center). During training sessions both punishments and rewards were used—slaps and screams for inattention or lack of cooperation (upper right), and food and approval promptly whenever the children made correct or socially constructive responses (lower pictures). All had been chosen for the project partly because food was important to them.

After several months, Billy was able to go home and attend a special school. Two years later he was doing first-grade reading and arithmetic, was liked by his teacher, and seemed happy, although his speech was often unclear and he still had some problems at home. The other children have made similar improvements (Lövaas, 1966).

nation of human behavior. For man there is certainly something between the S and the R—the rediscovery of personal responsibility. This is their main theme. In helping patients recognize and accept their responsibility, the Mowrer method makes considerable use of group therapy, in which open confession of past misdeeds is combined with concealment of present and future good works. Neuroses are regarded as forms of what is described religiously as a “state of sin.” In overcoming them, the role of the unconscious is played down, since the development of a sense of responsibility is of fundamental importance (Mowrer, 1964). It is too early to evaluate the worth of this new approach.

Briefer Forms of Psychotherapy

Recently there has been experimentation with less complex forms of therapy and in some cases relatively brief but deep-reaching techniques have been found effective.

Need integrative therapy. One brief form is need integrative therapy, in which the attack is focused on the basic present need behind the maladjustive behavior rather than on a search for unconscious causes of behavior dating back to childhood (Boileau, 1958). In this form of therapy all needs are regarded as acceptable, but some means of trying to fulfill them are considered neurotic. The patient may require help in understanding what his needs are and what behavior will be effective in satisfying them. He may find himself trying ineffectually to work toward goals that, although socially desirable, seem unrelated to what he really wants.

An example is the case of a student who found it difficult to study while seeking a degree primarily to please his parents and obtain status in later life. Rather than repeat the parents' estimate of the degree as unquestionably desirable, the therapist questioned the goal itself, and thus revealed underlying desires which the degree could help satisfy. When the student saw the relation of the degree to his own basic interest in mechanical work, he overcame his inability to study. A portion of an interview with the therapist follows:

Patient: “I seem to drop back in the same old rut. I messed around for four days. Didn't have any fun either because I should have been studying.”

Therapist: “What do you mean, ‘should have been studying’?”

Patient: “Well, if I'm ever going to get that degree . . . If I get another ‘D’ my old man will give me hell.”

Therapist: “What do you want the degree for?”

Patient: “Well, I can't be a bum all my life.”

Therapist: “Why not? Who says you can't?”

Patient: “You know sometimes I feel like just doing that . . . lying around on some island.”

Therapist: “Is there anything the matter with that?”

Patient: “Well, no, I guess not, but I'd like to have some dough and do a few things.”

Therapist: “If it won't get you what you want, I see what you mean.”

Patient: “Yeah, I'll get that degree, and if I can use it I will, and if not, I'll tell people to go to hell and be a mechanic. I really like messing around with cars, but I could never afford one. If that degree can get me a car, it will be worth something.” (Boileau, 1958)

Rational psychotherapy. Similar to the above technique in some ways is rational psychotherapy. The primary aim of this method is to discover how neurotic behavior is maintained, little emphasis being placed on how it was caused in the first place. Proponents of this method believe that most neurotics continue their irrational behavior because of irrational things they constantly tell themselves in a sort of self-dialogue, the elements of which must be brought to light. Among the most commonly held irrational ideas, instilled by parents or by the culture pattern, are that it is tragic not to be highly successful, that it is vitally important to be liked and approved of by everyone, or that one must rely on someone stronger than oneself. The therapist helps the patient discover what he is saying to himself and change it to something rational, such as that it is possible to be happy despite occasional disapproval from others. He also encourages the patient to act out his new ideas, painful though the process may be.

In one case, in which the patient was severely depressed and had alcoholic tendencies, it developed that he wished to learn the art of glass staining and

could do so only by holding the kind of job he had. However, the job involved considerable clerical work which was distasteful to him, and he was trying to avoid this work and blaming his boss for making him do it. The therapist made him realize that he was telling himself: "My boss makes me do inventory-keeping. I do not like to do this. . . . He is therefore a blackguard for making me do it. . . . So I'll fool him and avoid doing it. . . . And then I'll be happier." Because these ideas were so foolish that the client could not really believe them, he began to add others like these: "I'm not really fooling my boss, because he sees what I'm doing. . . . So I really should stop this nonsense and get the inventory-keeping done. . . . But I'll be damned if I'll do it for him! . . . However, if I don't do it, I'll be fired. . . . Oh, why must I always be persecuted like this? . . . And why must I keep getting myself into such a mess? . . . I guess I'm just no good. . . . And people are against me. . . . Oh, what's the use?" Instead of these sentences, which led to a vicious circle of depression, resentment, and further depression, the therapist suggested the patient should tell himself something like the following: "Keeping inventory is a bore. . . . But it is presently an essential part of my job. . . . And I also may learn something useful by it. . . . Therefore, I had better go about this task as best I can and thereby get what I want out of this job." In this way the therapist was able to use the problem of avoiding inventory-keeping as an illustration of the client's general neurosis. He showed him that his alcoholism was also a form of avoiding responsibility. The client was eventually led to see the importance of accepting the inevitable without illogically blaming others for it and was able to overcome his neurosis (Ellis, 1958).

Special Techniques in Therapy

There are several special techniques which may be employed by psychologists, psychoanalysts, or psychiatrists. They are used with many variations by different therapists and have proved successful adjuncts to both directive and nondirective methods of psychotherapy.

Psychodrama. The technique of psychodrama provides for direct expression of the patient's emotional disturbance, as he is encouraged to act out various life situations which are related to his difficulties. The theaterlike atmosphere

of psychodrama enables the individual to face his problems with less emotional tension than in real life (Moreno, 1946).

At the beginning of the session the therapist helps the patient outline the general situation to be enacted. Supporting roles in the drama are assigned to specially trained assistants. Once the scene is set, the patient plays his role spontaneously with the aid of the assistants, who help him "live" the situation realistically. The following case of a thirty-year-old soldier suffering from "combat exhaustion" illustrates the use of this method.

"Present Illness: Patient states he has been hearing voices for the past six weeks. The voices moan and groan, but he cannot make out what they say. 'It is the guy I killed, I see him too.' The patient was referring to an incident about six weeks previously when he had been on guard duty on the Rhine.

"A German soldier tried to come upon the bridge guarded by the patient, who had to shoot him. Although hit twice in the chest, the German tried to get to his feet. Another American soldier on guard with the patient shot him down. The patient said that although he had killed six men in combat, this was the only one that bothered his conscience.

"Psychodrama: The crucial scene in which the patient had killed the German was recreated with much realism. A ward man played the role of the German soldier, crouching and approaching the patient, and after having been 'shot,' writhed on the floor—moaned and groaned. The patient said, 'Please don't do that. That is how he looked when he died. I can see him in my sleep, on guard, or whenever I am alone. I sit down and wonder if that man will ever get off my mind. . . . He never talks, but just moans and groans.'

"The ward man got up, walking in front of the patient, who shut his eyes. After the session was over, the patient was breathing hard and was very much affected. The same episode was repeated on several successive days and the patient gradually lost his fears. He was constantly afraid of finding bodies in the hospital, say, in the basement under the ward. So we initiated a program of training to familiarize him with dead bodies. We acted out several scenes in which an assistant played the 'body,' making the patient touch the body, handle it, turn it around, etc. At one time the patient was placed in the role of an undertaker. At first he showed great reluctance to touch the 'body' but we pointed out to him that he was only an actor. In time the

patient overcame his fear of the dead, and thus received beneficial training." (Fantel, 1946)

By acting out his emotional disturbances in psychodrama, the patient is afforded a rich opportunity for catharsis—he is free to express his fears and inhibited desires spontaneously in an atmosphere which simulates real life but which does not bear all the physical and psychological threats of real life. In this atmosphere of security he not only is able to gain increased understanding of his own emotional problem but also has an opportunity to gain new adjustment skills which can be used in real-life situations.

Group therapy. In recent years, many efforts have been made to work therapeutically with groups as well as individuals. Group therapy is most often carried on nondirectively, although different therapists direct and guide the group's discussions in varying degrees. Regardless of its orientation, however, the group situation itself has been observed in every case to have a noticeable therapeutic effect upon the individual members. The benefits may range from the simple "misery loves company" type of reassurance to a deeper and more lasting personality change within the individual members. One of the ways in which group therapy has proved particularly useful is in helping patients to build better systems of values (Dreikurs, 1956).

Various techniques are used in group therapy, from play groups for preschool children to analytic groups for adolescents and adults, in which the emphasis is on interviews and discussion (Slavson, 1950). Children aged seven to thirteen may be placed in an activity group which meets once a week like a club and which provides opportunities for self-expression through arts and crafts—or through throwing the paints and tools instead. The children are allowed to act out their aggressions without criticism or restraint from the therapist, who truly accepts and loves each child. As the children develop a sense of their own worth, fears and conflicts diminish and more desirable behavior gradually emerges. This happened in the case of Richard.

At the age of twelve, Richard displayed violent temper tantrums in which he threw things at his parents.

He was also afraid of the dark, refused to wash and keep clean, could not get along with other children, and in general had a bad name in the neighborhood. His mother was tense and overprotective but often lost her temper, screamed, and beat her children. In activity group therapy, Richard soon showed rapid progress. He learned to reach out for friendships, tackled increasingly difficult tasks in the craft work, and even became a leader in the group. Similar improvement soon appeared at home and school. Meanwhile the mother received individual therapy, and eventually she and Richard achieved a much more satisfactory relationship (Slavson, 1950).

Group therapy has proved effective in some cases of schizophrenia. In one study it was found that female schizophrenics who received both group therapy and shock treatment showed greater improvement than those who received shock treatment alone (Peyman, 1956).

Currently group psychotherapy is being used with increasing frequency and in an increasing variety of ways (Mullan, 1957). Whole families may be involved in group therapy sessions, or the principals in a conflict (a mother and son or a brother and sister, for example) may derive benefit from a group session with a therapist.

Multiple therapy sessions involving more than one therapist may also be used. An incidental benefit is felt to be the decrease in the use of "artifacts" such as observation screens, projectors, or even notebooks, which sometimes interfere with the course of therapy.

Certain individuals appear to derive less benefit than others from group therapy, and as many as one fourth or one third of the members often drop out of groups. In seeking an explanation for this, psychologists have identified three personality characteristics which apparently enable a person to derive maximum benefit from group as opposed to individual therapy. These are willingness to form relationships with others on an emotional level, ability to express rather than repress anger, and flexible perception of authority.

Thirty-two neuropsychiatric nurses and nursing assistants who had volunteered for a series of group sessions designed to aid them in their work by helping them gain insight into their own emotions were first seen

■ A counselor at the Community Child Guidance Centers in Chicago is talking with two children in their mother's absence. Other mothers watch and listen, comparing this family's problems with their own.



in an interview designed to measure the three characteristics. Each was assigned a score for each characteristic. At the end of the fifteen-week course of sessions, each member was asked for her positive or negative reactions to the course. Nurses who tended to be emotionally "encapsulated," very cautious about relating to others on an emotional level, were significantly less favorable in their reactions than were those not classed as encapsulated. Significant relationships were also found between scores on the other two characteristics and degree of satisfaction with results of the course. Moreover, a group especially selected from girls high in the three personality characteristics achieved unusually fruitful results from the therapy sessions on a wide variety of topics (Gruen, 1966).

It should be noted that individuals high in the three characteristics conducive to successful group therapy are not necessarily better adjusted as a whole than others. They may be neurotic in other respects, while the emotionally encapsulated may show a high degree of personality integration and may respond readily to individual forms of therapy.

An interesting variant of group therapy is used at the Community Child Guidance Centers in Chicago. Several mothers watch a counselor interview a troubled mother and then, in her absence, her children. The children then return to a playroom, where their behavior is

observed and later reported to the group. The mother comes back to discuss the situation with the counselor. This procedure may be repeated weekly until the problems are under control. Several cases are considered at each session, and it is customary for a mother to attend several sessions as an observer before her own problem is taken up.

Play therapy. Play therapy, whether group or individual, is aimed at releasing pent-up emotionality through the use of various play techniques. This type of therapy is often used in the treatment of behavior problems in young children. During a play therapy session the child is usually allowed to express himself spontaneously, with little guidance or interference from the counselor. Perhaps for the first time he has an opportunity to give full vent to his feelings without fear of punishment or rebuff.

One popular form of play therapy is *doll play*, illustrated in the photograph on page 466, in which the therapist provides the child with a furnished doll house and a "family" of dolls. The child is encouraged to play with the dolls in any way he likes and is told that he can make them do anything he wants. In general, the situations created by the child are based on



■ In this play therapy session, the boy has painted a picture of his brother and is pelting it with clay bombs. This, among other procedures, helped him to work through the jealous, hostile feelings that were producing serious behavior problems. After a time, he got along better at home, no longer set fires, and moved from a slow reading group to advanced achievement.

his own family experiences. But in contrast to real life, the child now finds himself in control of the family situation and so is able to change the characters' actions in such a way as to satisfy his own unfulfilled desires (Sears, 1951). Thus he may punish or even mutilate a doll which he has identified as a parent or sibling toward whom he feels hostility and resentment. Or he may represent himself as receiving wanted affection in the arms of his mother. Play therapy, in other words, permits the child to "act out" his emotional problems without danger of unpleasant consequences.

In using play therapy, the clinical psychologist may simply accept the child's expressions of his repressed and suppressed feelings, or he may go further and interpret them with the child—depending on the individual case and on the therapist. With or without such interpretation, children benefit from play therapy because it affords both an outlet for pent-up emotion and an opportunity to "experiment" with solutions to their problems that they do not dare try in real life.

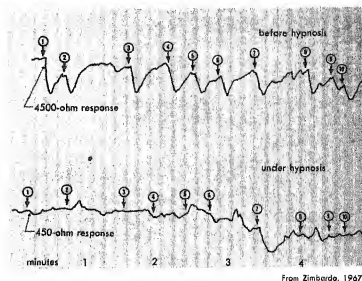
Some therapists use persuasive doll play, in which they attempt to induce changes in the child's behavior through a sort of rehearsal in doll play (Mann, 1957). That is, the child's problems are attributed to a doll and he is persuaded to modify this doll's behavior in such a way as to solve the problems. This technique, like the action therapies, treats symptoms rather than helping the child work through his problematic feelings.

Although play therapy is used primarily with children, a similar type of therapy which allows the patient to express himself through creative art has been used with some success in the treatment of adults (Huntoon, 1949). Activities such as painting and sculpture provide the adult patient with a means of discharging his negative feelings toward reality and of replacing them with positive feelings of accomplishment.

Hypnosis. There is nothing mysterious about hypnosis. It is simply a highly suggestible state into which a willing subject is induced by a skilled operator. In hypnosis, the subject becomes willing to concentrate exclusively on the situations, actual or symbolic, presented by the hypnotist (Leuba, 1960). The hypnotist may

SUPPRESSION OF PAIN BY HYPNOSIS

The reality of pain suppression under hypnosis is demonstrated by this record comparing a subject's GSR responses to strong shocks before hypnosis and after being hypnotized and told that the shocks would not hurt. (In both cases the shocks were given while he was learning a list of words.) The drops in the upper line following each shock are measures of the magnitude of response and are virtually missing in the second line except after shock 7. At this point there were muscular indications that the subject was coming out of the hypnotic trance. The experimenter re-established the trance, and, as you can see, further shocks again brought little or no galvanic or muscular response.



direct the subject's concentration and perceptions to such an extent that he does not feel a pinprick or other mildly painful stimulus or, on the other hand, feels pain for which there is no physical stimulus. Adequate motivation and respect for the hypnotist are usually facilitating factors, although it is possible for a subject to be hypnotized when he does not realize it or when he does not wish to please the hypnotist.

The methods of inducing hypnosis are too numerous to describe, but they all follow similar principles (Pattie, 1956). The operator, speaking in a monotonous tone to induce complete relaxation, may start by asking the subject to execute some simple act, such as lying down on a couch. Then the subject is told something which is obviously true—perhaps that the room is quiet and the lights are low. His confidence

won, the subject is told a partial truth and is asked to execute acts which are only slightly out of the ordinary. For instance, he is told that his eyes burn and that his eyelids feel heavy. In a greater state of suggestibility, the subject may be led to believe the obviously untrue and to perform acts which he would not ordinarily think possible.

Hypnotic suggestion. Once the subject is hypnotized, he can be given a wide variety of suggestions which he will readily accept. A hypnotized person cannot perform a physically impossible feat (such as floating in the air or lifting a 1000-pound weight), although he can be made to believe that he is doing so. The hypnotist can, however, produce and banish at will many of the symptoms of conversion reaction, asthenic reaction, anxiety reaction, and related conditions. A subject can be made temporarily blind or deaf, or he can be made to see and hear things that are not there. Contrary to popular belief, he can be made to perform antisocial acts or dangerous acts if the hypnotist can make him believe that such behavior is normal and proper (Barber, 1957). For example, the subject will readily steal another person's billfold if the hypnotist arranges the situation so that the subject believes the billfold is really his own.

The effects of hypnotic suggestion are not limited to events that occur during the hypnotic trance: the operator can make suggestions which will affect the person's behavior after the hypnotic session. Posthypnotic suggestion is usually effective for only a few days, but recent research has indicated that under certain conditions attitudes as well as overt behavior may be affected over much longer periods.

In one study, hypnotized subjects who were commanded to have new, specified feelings toward housing integration and foreign aid retained their changed attitudes for several weeks, even when they were told how the change had occurred. Tests also revealed extensive changes in their whole cognitive structure, which kept their new attitude from being inconsistent with their other knowledge and beliefs and which lasted as long as the new attitude did (Rosenberg, 1960).

Through posthypnotic suggestion, pain and symptoms growing out of organic as well as psychological disturbances can temporarily be

suppressed. This type of hypnotic treatment can be dangerous, however, if it is used in place of, instead of as an adjunct to, direct medical treatment, since it only removes the danger signal of pain without curing its cause.

Hypnotic regression. Hypnosis can also be used to establish regression. The hypnotized subject is told that he is at a younger age and is asked to tell what he has been doing, how he feels, what his ambitions are. Under hypnosis, a subject will vividly recall and relive experiences that he has forgotten or repressed for years.

In one study, fifty subjects ranging in age from twenty to twenty-four were asked, before the trance was induced, to state the day of the week on which certain relatively recent events had taken place. The number of correct answers was so small that they could be attributed largely to chance. Under hypnosis, the subjects were then regressed year by year and quizzed about memorable chronological landmarks as they went back in time. Under these conditions, over 90 per cent of the subjects were able to state the correct day of the week (as checked against a perpetual calendar) on which Christmas and their birthday had fallen when they were ten years old. The subjects were only slightly less accurate in stating the day of the week on which their fourth birthday had fallen (True, 1949).

This study would have been more conclusive had the subjects been asked—first in a waking state and then under hypnosis—to recall childhood experiences that occurred at different age levels. Recall under the two conditions could then be more fully compared. Waking recall usually improves if the experimenter supplies the subject with memorable chronological “landmarks” and gives him ample time to remember.

Various studies in hypnotic regression have shown that when subjects are taken back to a particular age and asked to write their names, they use the same handwriting they actually used at that age, as shown by comparison with actual specimens of their earlier penmanship. ♦

Clinical experience has demonstrated the value of recall during hypnosis in recapturing repressed experiences and thus giving the clinician insight into the patient's problems. Later, when the patient is in a waking state, the thera-

pist can guide him along lines suggested by the hypnotic revelations.

The therapeutic value of hypnosis is recognized by professional and religious organizations, and it has become an accepted technique in psychotherapy. Some insight psychologists, however, feel there is a danger that the patient will become dependent upon hypnotic treatment to remove his superficial symptoms, leaving his underlying problem unsolved. This is a matter to be resolved by future research.

Whatever the value of hypnosis in the hands of the competently trained individual, it is *not* a technique to be experimented with in the dormitory or fraternity house, for while the amateur can easily master the technique of inducing the trance state, he cannot be trusted to recognize and cope with possible harmful after-effects. There is always a danger that the amateur hypnotist will, through his suggestions, seriously distort the unconscious emotional patterns of his "patient."

Common Characteristics of Different Methods

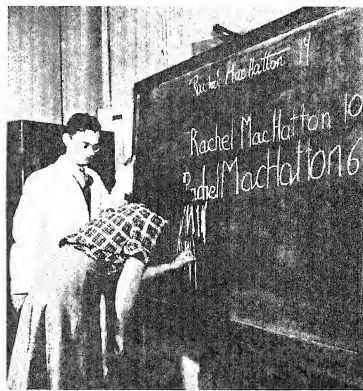
Since therapeutic gains have been achieved by a wide range of methods, one psychologist has attempted to isolate the factors that seem to be common to most methods of therapy. The characteristics of successful psychotherapy, as seen by this investigator, are:

1. The therapist shows a genuine concern for his client.
2. The therapist establishes an atmosphere of nonretaliatory permissiveness: the client is not punished or rejected for what he says.
3. The relationship between therapist and client is one of honesty and understanding. The clinician helps the client to interpret or clarify his feelings and reactions. He tempers his permissiveness by awarding approval to the client for his efforts to think more clearly about himself.
4. The relationship is one-sided, since the therapist does not share his own troubles, nor does he ordinarily intervene in the client's outside life.
5. The content of conversation in the clinical situation is concerned with the client's values, motives, and emotions (Shoben, 1953).

This investigator's theory is that neurosis is essentially social in origin and that psychotherapy represents a special kind of secure social situation in which the process of socialization can be reconstructed. The personal anonymity maintained by the therapist enables the patient to react to him not as a specific individual but rather as representative of "people in general." This fact, in turn, helps the patient carry over to his outside life the new understanding and patterns of thinking gained in the therapeutic situation.

Evaluating Psychotherapy

Overall evaluation of the effectiveness of psychoanalysis or other forms of therapy offers many difficulties. For one thing, it is hard to distinguish superficial changes in behavior from fundamental underlying changes, and important changes may occur too slowly to be in evidence when therapy ends or even at the time of



At the top is the subject's normal handwriting; next is her handwriting when hypnotized and told she was ten; then her handwriting when told she was six. At earlier ages it became the unintelligible scribble of a preschool child.

a follow-up study. The unique interaction between the personalities of the patient and the therapist in each case under treatment adds further to the difficulty of evaluation.

Obtaining true control groups is virtually impossible, since no psychotherapist would want to withhold therapy from a group of patients in order to compare them with another group receiving treatment. Even if he used as controls a group of patients who were similarly diagnosed but who, for financial or other reasons, did not receive treatment, there might be a selective factor working that would make the two groups incomparable. Yet without adequate controls, there is no way to be sure that the therapy was responsible for recovery; perhaps the patients would have recovered without it.

Determining what constitutes a cure is an important part of the problem. To what extent is the alleviation of a symptom evidence of recovery? Is improved behavior in the hospital a true criterion of progress? What factors are most important in indicating good adjustment after release from the hospital?

Even doctors do not always evaluate the same result in the same way.

In one case, a hospitalized patient who had refused to eat with the others in the group began to put two to four bottles of milk on his tray and drink it with the others. The therapist regarded this behavior as a sign of improvement, but a psychiatric consultant held that it showed regression to the infantile level (Luchins, 1960).

For these and other reasons, there are not as many follow-up studies as could be wished, and those there are do not always agree.

One psychologist created a furor by reporting the following figures for groups given psychoanalysis, eclectic treatment (see page 535), and no psychotherapy, respectively (Eysenck, 1952):

Treatment Method	Per Cent Cured
Psychoanalysis	44%
Eclectic treatment	64%
No psychotherapy	72%

It was soon pointed out that the "no psychotherapy" patients had probably not been comparable to the treated

ones. Some were insurance disability cases; the others were patients in a state hospital, where the criteria of improvement are typically lower than the criteria used by therapists in private practice. Furthermore, the insurance disability cases may have received some therapeutic help from the general practitioner they consulted and the hospital patients from the generally therapeutic surroundings of the hospital (Rosenzweig, 1954).

In another study, the effectiveness of psychoanalysis was evaluated on the basis of several criteria. A psychoanalyst examined twenty-eight patients he had treated eight to twenty-four years previously for an average period of two years and three months. All had been chronic neurotics. The aim of this study was to evaluate lasting personality change—as determined by the reports of the patients themselves, the judgment of the analyst, and judgments made by objective observers some time after the end of treatment.

The most lasting personality changes reported by the patients were in interpersonal relationships. Of the twenty-eight subjects, twenty-five stated that analysis had made a permanent change for the better in their ability to get along with people and to feel more at ease. None found it more difficult. In twenty-two cases there was a lasting change in ability to work and to enjoy work; none of the patients reported any lessening of this ability after analysis. A decided improvement in the ability to enjoy life was reported by fourteen patients and a lasting improvement in sexual adjustment by fifteen patients. In this regard it was noted that, contrary to popular opinion, the removal of neurotic sexual inhibition had not led patients to disregard necessary social restraints on sexuality but rather had freed them from the compelling role of sex as a motive power. Twelve of the patients reported a lasting change in their perception of reality, using such words as: "a different way of perceiving"; "a richer gamut of experience"; "I have come out of a fog."

It was found that analysis had had a marked effect on personality even in the cases where symptoms had not changed to any extent. Almost all the patients held positive attitudes toward analysis as a form of treatment—despite the fact that analysis may always seem something of a disappointment, since patients tend to expect "miracles." In this study the psychoanalyst's own evaluation of results was: seven cases, very satisfactory; fifteen cases, satisfactory; two cases, unsatisfactory; and four cases, inconclusive. Of the patients themselves, ten considered results as very satisfactory; three considered results as between very satisfactory and satisfactory;

twelve considered results as satisfactory; two gave indefinite replies; and one stated that results were unsatisfactory in regard to his homosexuality but otherwise satisfactory (Schjelderup, 1955).

Many more studies are needed to establish the validity of the various methods of psychotherapy and to help bring clinically derived concepts into the realm of science. Comparisons of the effects of different therapeutic methods, although difficult to obtain, are particularly needed. A beginning in this direction was made in one ward of a large Veterans Administration neuropsychiatric hospital.

Four groups of patients were observed, each group containing an equal representation of nonpsychotics, short-term psychotics, and long-term psychotics. In one group, work and living arrangements, as well as psychotherapy, were group-oriented. The second group received group therapy but had individual work assignments, while the third group had individual therapy and individual work assignments. The fourth group acted as controls; they were given the routine individual work assigned to all patients in the ward but received no therapy.

Patients in group therapy required the shortest time in treatment, with those in individual therapy requiring the longest time. This criterion, important to the hospital from an economic standpoint and often used in evaluating psychotherapy, showed no correlation with later adjustment, nor did the use of tranquilizing drugs. The follow-up criterion of successfully holding a job after discharge revealed that all three therapy groups were significantly superior to the control group, with the first and third groups having the highest percentages of full-time employed members (Fairweather, Simon, Gebhard, Weingarten, Holland, Sanders, Stone, and Reahl, 1960).

Another comparative study evaluated different methods of psychotherapy employed by the same therapist over a period of years.

The therapist had begun as an orthodox psychoanalyst; after about three years had turned to a more active, face-to-face but still psychoanalytically oriented therapy; and after three more years had changed to rational therapy. Having kept careful records and evaluations of all cases, he was able to compare seventy-eight cases treated by rational therapy with seventy-eight treated by psychoanalytically oriented therapy, each group

including sixty-one neurotics and seven borderline psychotics. Only sixteen cases treated by orthodox psychoanalysis were studied. Percentages of patients showing improvement under various methods of treatment are shown in the table.

	Distinct Improvement	Considerable Improvement	Little or no Improvement
Orthodox psychoanalysis	37%	13%	50%
Psychoanalytically oriented therapy	45	18	37
Rational therapy	46	44	10

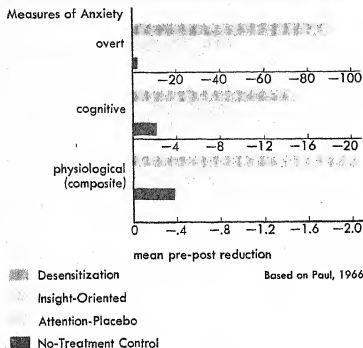
Rational therapy showed itself slightly superior to the other two methods. It worked best with fairly intelligent, fairly young individuals with mild disorders. There was no evidence that it was more suited to one type of disorder than another (Ellis, 1957).

These results must be viewed with caution, for they also show that the therapist himself kept changing for the better. Perhaps they simply reflect increasing skill on his part or perhaps he changed because he was unable to use the first two methods successfully. Or perhaps it may have been a case of finding what he expected and wanted to find—greater success with the method he had come to prefer. Evaluation of the improvement by someone else without knowledge of the method used in a given case would have produced more objective evidence.

During the past few years, as action therapies have gained in popularity, various attempts to compare their effectiveness with that of the older insight therapies have been and are being made. The question of which approach is more effective is particularly hard to resolve because of the difficulties inherent in evaluating the results of psychotherapy and in setting up controlled experiments on disturbed human beings. A recent experiment overcame some of these difficulties by choosing for study an area of stress sufficiently limited to allow rigorous controls but important enough to permit generalization of the findings. Since, as we have seen,

▲ REDUCTION OF ANXIETY

Three types of anxiety measures were used: overt, involving observers' ratings of behavioral signs of anxiety; cognitive, derived from subjects' scores on the Anxiety Differential; and physiological, including measures of pulse rate and palmar sweat. On all three there was greater reduction of anxiety in the Desensitization group than in the other three.



anxiety is at the root of most neuroses, it was decided to use interpersonal-performance anxiety, specifically that induced by the stress of a public-speaking situation, as the condition to be treated by psychotherapy. Such anxiety, while it seldom, if ever, makes an individual's life unbearable, can hamper performance in public, as well as being extremely unpleasant to experience, as anyone who has had stagefright knows only too well.

A total of 710 students in a required public-speaking course completed a battery of anxiety and personality scales. With these was a letter explaining that a study was being made of anxiety connected with public speaking and that help in overcoming such anxiety would be available for a limited number of students. Those who were interested in receiving help were asked to indicate their willingness to participate. From those who indicated an interest, ninety-six who scored high in anxiety on the test battery were used as subjects in the experiment. Of these,

seventy-four were asked to give a test speech. Immediately before he made his speech, various measures of anxiety were made on each subject, including his pulse rate and Palmar Sweat Index. During the speech, he was observed by four trained graduate students who indicated on a checklist the presence of physical manifestations of anxiety, such as shuffling of feet, trembling knees, quivering voice, and heavy breathing.

After the test speech, these students were assigned to one of four groups. The remaining twenty-two subjects formed the *No-Contact Classroom Control Group*. They never knew they were a part of the experiment but simply took the regular speech course. Any decrease in their anxiety could, therefore, be attributed to classroom procedures alone. After the treatment period was up, the effectiveness of the various forms of therapy was judged on the basis of measures obtained from a criterion test speech and a follow-up battery of personality and anxiety tests.

Five experienced, reputable psychotherapists were paid to participate in the study. All tended to favor the insight approach to therapy, but were flexible enough to use a different approach. Each therapist administered each form of treatment. Students were treated individually, receiving five fifty-minute sessions over a period of six weeks. The forms of treatment were as follows:

Modified Systematic Desensitization (Group D). This treatment was a slightly modified form of the Wolpe method of therapy. A hierarchy of anxiety situations was individually tailored to the particular student. The hierarchy would begin with an item like "reading about speeches alone in room, two weeks before a presentation," and work up to the actual presentation of a speech to a large audience. After a brief period of practice in relaxation technique, items from the anxiety hierarchy were visualized in accordance with the procedure described on p. 514. The therapists had been intensively trained in this procedure and were instructed to maintain the same warm, helpful attitude as in the insight form of therapy.

Insight-Oriented Psychotherapy (Group I). In the sessions for this group, the therapist used traditional interview procedures designed to help the patient gain insight into the roots of his problem. Reflection, clarification, and interpretation of the student's feelings played a large part in the therapeutic process.

Attention-Placebo (Group AP). These students were told that their anxiety was largely the result of a low tolerance for stress and that this could be overcome by training. The training was to consist of working, while under the influence of a "fast-acting tranquilizer," at a

stressful task that usually induced considerable anxiety. The drug would prevent the subject from experiencing anxiety during the task and he would gradually build up a tolerance for stress so that he could successfully cope with stressful situations, such as giving a speech, without the aid of the tranquilizer. The "very stressful task," identifying "disaster signals" from a number of tape-recorded sonar signals to which the subject listened through a headset, actually was one which usually induced drowsiness.

After giving the subject a placebo capsule of baking soda, the therapist left the room for ten minutes to "allow the drug to take effect." When the therapist returned he "checked" the subject's pulse and the pupils of his eyes before announcing that the "drug" had taken effect. At the close of the session the therapist again took the subject's pulse and pupillary response and told him that the drug had dissipated. Although the subject had the therapist's attention during these sessions, he had no chance for catharsis or for seeking any kind of therapeutic help because he was listening to the tapes throughout most of the session.

No-Treatment Classroom Control (Group TC). In addition to the twenty-two no-contact control subjects,

who participated unwittingly, an additional control group of twenty-nine subjects also took the regular classwork and received no treatment. However, they did receive some attention and knew they were part of the experiment. After they gave the test speech, they were interviewed and told that unfortunately one of the therapists was unable to work with students that semester but that treatment would be provided for them the following semester if they still wanted it. They were requested to return anyway to deliver another test speech at the same time as the treated students so that the data would be complete.

The most stringent test of treatment effects was analysis of the change in anxiety scores from pretreatment to posttreatment stress-condition measures, which were made when the criterion speech was delivered at the close of the experiment. All three treatment groups improved significantly more than the no-treatment controls, the systematic desensitization group being consistently superior to both the insight and the attention-placebo groups in all measures of anxiety. In addition, more individuals in the desensitization group were regarded as "significantly improved" on all three measures (Paul, 1966). ▲

PHYSICAL METHODS OF THERAPY

The distinguishing feature of the psychiatrist—whatever theory of personality and psychotherapy he advocates—is his medical training. In the psychiatric treatment of severe emotional disturbances, particularly where there is considerable loss of contact with reality, various physical methods of therapy often are combined with psychotherapy or used by themselves. Such medical measures range from the use of special diets to the application of chemical sedatives or the artificial induction of violent convulsions. It should be emphasized that such "physical psychiatry" is not always intended to cure the individual's emotional disorder but may be used in an attempt to prevent some extreme act such as homicide or suicide or to make the disturbed patient receptive to psycho-

therapy. The most prominent of these physical methods are shock therapy, narcosis, chemotherapy, nutrition, and psychosurgery.

Shock Therapy

Severely disturbed patients who would once have been considered hopeless have responded favorably in some cases to artificially induced seizures or convulsions. Such treatment, known as *shock therapy*, became routine in most mental hospitals after World War II but is considerably less common since the discovery of new techniques of chemotherapy. Although a number of different techniques have been used in shock therapy, one feature they have in com-

mon is inducing a state of coma lasting for several minutes to several hours after the shock. It is not entirely clear whether the coma itself is the therapeutic factor or whether the value of shock is due to some other factor—such as physiological changes in the nervous system or the creation of a violent psychological reaction (Noyes, 1948). Another possibility is that for depressed patients its effect is mediated through guilt reduction, the shock being viewed as "punishment" for actual or imagined transgression.

Insulin shock. One of the oldest forms of shock therapy involved the administration of insulin, which produces a prolonged coma by reducing the sugar content of the blood and thus depressing metabolic processes in the brain (Sakel, 1937). When combined with psychotherapy, this method proved to be effective in treating schizophrenia, producing some degree of lasting improvement in approximately 45 per cent of cases (Jessner and Ryan, 1941). Insulin therapy is rarely used today, however, since certain drugs, to be discussed later in this chapter, have proved to be helpful in treating schizophrenia. Present medical thinking on insulin shock has been well summarized by a British psychiatrist:

"There is no doubt about the value of [certain drugs] in acute schizophrenia. They have revolutionized its treatment, and have killed insulin shock treatment stone dead. It is true that the corpse still quivers occasionally in one or two remote places where there are still one or two insulin shock centers, but it can still be said that insulin shock treatment has disappeared from psychiatry." (Hamilton, 1965, p. 293)

Another early form of shock therapy, using the drug *metrazol*, has been abandoned because of the intense fear experienced by the patient and the danger of broken bones during the convulsion which precedes coma (Kalinowsky and Hoch, 1952).

Electroconvulsive shock. The most recently developed and by far the most widely used form of convulsive therapy is electroconvulsive shock. The patient is placed on a bed and securely padded or held firmly by nurses and

attendants to prevent injury during the convulsion. Often the patient is given muscle relaxants to decrease further the possibility of bone fractures or too-strong muscle contractions. Electrodes are then fastened to his head, and a current ranging from 70 to 130 volts is applied for a fraction of a second. Twenty, thirty, or more such treatments may be required, although in some cases fewer are needed.

This type of treatment is preferred today to shock therapies which depend upon drugs. In the first place, loss of consciousness is immediate and there is no memory of the event, so that the patient does not develop the panic common in *metrazol* therapy. Moreover, there are seldom any complicating aftereffects or injuries due to the electrically induced convulsion. Electroconvulsive shock has proved particularly effective in cases of severe depression. It has been valuable in saving patients who might otherwise commit suicide, and it usually alleviates feelings of guilt and self-accusation (Noyes, 1948).



This patient is being prepared for electroconvulsive shock therapy. She will be held down firmly while the current passes through the electrodes applied to her head. Afterward, she will be more responsive to psychotherapy than before, and with successive treatments her period of contact with reality may gradually increase until finally there is no relapse at all.

Conflicting results have been obtained, however, in regard to its benefits. Many psychiatrists believe that this drastic form of treatment will be used less and less in the future; it is already being supplanted by drugs and new techniques of psychotherapy (Wortis, 1963). There is some evidence that electroconvulsive shock has adverse effects on learning and retention (Leukel, 1957; Stone and Bakhtiari, 1956). Certainly it disrupts the integrated functioning of the organism and perhaps should be reserved for use only in the most stubborn cases.

Narcosis

Narcosis (from a Greek word meaning "benumb") makes use of sleep-producing drugs, including *sodium amytal*, *sodium pentothal*, and *scopolamine*. This type of therapy may take either of two forms: prolonged narcosis or narcoanalysis.

Prolonged narcosis. In prolonged narcosis the patient is kept asleep under the influence of drugs for fifteen or more hours a day during a period of one to two weeks. Although an apparently simple type of treatment, prolonged narcosis is actually quite difficult and dangerous to administer, and the patient must be kept under constant observation while he sleeps. Since a number of physiological complications may develop under prolonged sleep, the technique is seldom used today, although it was quite popular before the development of the shock therapies.

In present-day practice, prolonged narcosis is used primarily as an emergency measure to quiet severely agitated patients. Its main effect, apparently, is sedative and temporary, and it is a much more severe form of treatment than its results usually justify.

Narcoanalysis. Considerably greater success has been reported with narcosis in its brief form, known as *narcoanalysis*. In this method drugs such as *sodium amytal* are given in amounts sufficient to cause "grogginess" but not unconsciousness—the patient remains in a state of "twilight sleep." The method is fre-

quently used as a substitute for hypnosis because it can be induced faster and more easily than a deep hypnotic trance.

By direct suggestion, the patient under narcoanalysis is encouraged to talk about or act out his painful experiences. Once exposed by this method, repressed emotions may be better understood and accepted by the patient. Because the individual is in a state of semi-sleep, however, his revelations often mix fact with fantasy and, like dreams, require the therapist's interpretation. For this reason, *sodium pentothal* and *sodium amytal*—popularly publicized as "truth serums"—actually have no value in legal investigation except as a means of turning up leads. Information obtained by such means cannot be used as direct evidence (Redlich, Ravitz, and Dession, 1951).

Narcoanalysis is most effective when employed soon after symptoms of repressed emotional tensions appear. It has proved particularly successful in the rapid treatment of the emotional tensions produced by combat and the frustrations of military life (Horsley, 1944; Grinker and Spiegel, 1945). The following case is typical.

"A twenty-two-year-old male of stable rural background completed high school at seventeen and farmed until inducted at twenty-one. Although 'bothered' by the noise and concussion of his ship's guns, he had no symptoms until his ship was attacked by a number of enemy suicide planes, four or five of which actually dived into his ship. On admission patient was dazed, confused, mute, and seemed to be deaf and unable to read or comprehend written questions. The first pentothal interview, about eighteen hours after his ship was hit, was unproductive except for showing that patient was neither deaf nor mute. He muttered something about a 'cheap drunk' but seemed too exhausted to respond further. Afterwards he was as dazed, confused, and unresponsive as before. A second pentothal interview, two days later, led to free verbalization, but without remarkable affective display. He appeared apprehensive, rubbed his left elbow, and was restless. He described the separate attacks of four suicide planes while he was at his gun station. He fretted over the loss of his gun loader and feared the gun firing above him as much as the enemy. As the effect of the pentothal wore off he continued to talk freely. After two days he remained animated and symptom-free except for slight dizziness



● These pictures show different stages in the treatment of hysterical lameness by narcoanalysis. A soldier, suddenly mysteriously lame, is brought to the psychiatrist's office, where he is injected with a barbiturate drug. Before putting him to sleep, this drug allows him to pour out his unpleasant experiences (top). After the drug has worn off, the psychiatrist goes over the interview with the patient and encourages him to try walking (center). A few days later he is well enough to play baseball (bottom).

with sudden changes of position. He recalled that one plane hit near his battle station, and it may be assumed that he suffered some blast concussion." (Orr, 1949)

Narcoanalysis is usually followed by physical rest, elaborate reassurance, and a program of recreation, as the patient gradually readjusts to the demands of reality. ●

Chemotherapy

During the past ten years, psychiatrists have employed several new drugs for treating mentally ill and emotionally disturbed persons. Evaluation of the effectiveness of new drugs must always take into account the possible power of suggestion in bringing about improvement. Physicians have long known that patients' discomfort could often be eased by the use of placebos that the patients believed were medicines. Many studies have now shown that placebos also help many patients suffering from psychogenic illnesses or even mental illness. For example, in a survey analyzing studies involving 14,177 patients and many different disorders of varying origins, it was found that the overall average of those responding favorably to placebos was 40 per cent (U. S. Public Health Service, 1963). The figures varied considerably from one disorder to another; several of those found are listed below.

Illness or Ailment	Per Cent Responding to Placebos Alone
headache	61.9%
neurosis	34
psychosis	19
alcoholism	22
asthma	5
hay fever	22
skin diseases	21
gastrointestinal disorders	58

An interesting sidelight is the finding that the method of administration may be an important factor in determining response to a placebo. One doctor found that the same placebo administered in a bright red gelatine capsule brought favorable results in 81 per cent of the

cases tested, as compared to only 49 per cent when it was administered as a tablet and 69 per cent when administered as a liquid (Clauser and Klein, 1957). Hypodermic injections are usually more effective than tablets but are inferior to capsules. While blue or green solutions bring better results in preparations applied externally, liquids to be swallowed are more effective if colored in warm tones of red, yellow, or brown—and if they have a bitter taste (Leslie, 1954).

A study that points up even more directly the need to separate drug effects from placebo effects in analyzing the effects of drugs on mental disorders was conducted with pharmacy students who were asked to help in the "testing" of two new drugs.

All forty-five students took a capsule at 8:30 A.M., being told that its maximum effects would be felt in about two hours and would disappear by the close of the experiment at 12:30. Fifteen were informed that their capsule contained a stimulant. Another fifteen received the "tranquilizer," and the remaining fifteen were told that their capsules contained only cornstarch (as did all capsules, in reality), since a control group was needed in order to obtain an accurate assessment of the effects of the two drugs.

At the beginning of the test the students took each other's pulse rates and were administered an adjective checklist which had previously been found to discriminate between persons under the influence of stimulating and tranquilizing drugs. Again at 11:30 and finally at the close of the period, pulse rates were taken and the checklist administered. Subjects were also asked for a subjective report as to whether or not they had felt any effects of the drug.

Overall, 60 per cent of the experimental subjects reported feeling the effects they were supposed to feel. This result was more pronounced among the "stimulated" subjects, 73.3 per cent of whom reported feeling the effects, as compared to only 46.7 per cent of the "tranquilized" subjects. This could have been at least partly due to the fact that the experiment took place during a regular laboratory class, in which the students were required to do their usual work despite the fact that the experiment took up some of their class time. The need to hurry may have interfered more with the tranquilizing than with stimulating effects. Performance on the checklist was in the direction predicted, but not significantly so. However, there was a significant

difference in pulse rates. The pulse rates of the "stimulated" group rose at the second reading, taken during the supposed time of maximum effect of the drug, and fell again by the close of the period. Those of the "tranquilized" group fell and rose again by the close of the period. Those of the control group rose slightly during the period, possibly owing to the pressure of completing their laboratory tasks (Brodeur, 1965).

Recent testing of the effects of new drugs on psychological processes has been more sophisticated than the testing given the earlier drugs. It is now recognized that the effectiveness of a drug over and above that of a placebo must be clearly established in studies making use of a strict *double-blind* technique, in which neither the subjects nor the individuals evaluating the results are aware of which individuals have received the drug and which have received the placebo. The drugs most often used in chemotherapy fall into two general classes: *tranquilizers* and *energizers*.

Tranquilizers. One of the most widely tested drugs, *reserpine*, comes from the root of the plant *rauwolfia* (snakeroot), whose medical properties have been recognized in India for thousands of years. Clinical use of reserpine began in this country after it was discovered that the drug was of value in treating hypertension (high blood pressure) and that it also had a calming effect on patients (Ciba, 1954). An early investigation showed that this drug seemed to make patients less inhibited and more outgoing during psychotherapy (Kline, 1954). Other investigators reported patients given reserpine showed tendencies toward greater personality integration and a higher degree of emotional control (Dice, Bagchi, and Waggoner, 1955). A later study, however, using as subjects patients complaining of various symptoms of anxiety, showed no significant difference in the improvement of those treated with reserpine and those who received a placebo (Segal and Shapiro, 1959).

Another drug, *chlorpromazine*, has been used with patients who do not respond to reserpine. There is evidence that chlorpromazine acts on the "reward centers" in the hypothalamus (see p. 435), which are closely related to various drives. It seems to exert a selective effect on

these centers, modifying results produced by stimulation—a phenomenon with infinite possibilities for further research (Olds, 1958). In general, chlorpromazine has been found to produce indifference and is considered useful in the treatment of disorders involving overactivity, such as manic behavior or obsessional activity.

In a comprehensive study of 1090 patients treated with chlorpromazine and followed up for three years, it was found that anxiety reactions responded far better than any other disorder to this treatment. A major advantage of chlorpromazine brought out in this study is that it can readily be used at home. In fact, 40 per cent of patients who would formerly have had to be hospitalized were seen as outpatients. The overall effectiveness of chlorpromazine was shown to be approximately double the 30 per cent effectiveness of a placebo (Winkelman, 1957).

Another study, however, found only very slight superiority of chlorpromazine to either a placebo or certain other drugs, thus showing that very great care must be taken to control incidental variables, such as the effects of suggestion, when evaluating drug therapy (Levin, 1959).

In a more recent double-blind study of a large number of patients suffering from depressive, manic, and anxiety states, chlorpromazine (in combination with another drug called procyclidene) and imipramine, an energizer, both showed significantly better results than a placebo (Fink, Klein, and Kramer, 1965).

Chlorpromazine has also been shown to be effective in the treatment of schizophrenia.

In a large double-blind study involving 692 men with schizophrenic reactions in thirty-seven Veterans' Administration neuropsychiatric hospitals, the relative value of chlorpromazine, promazine, phenobarbital, and a placebo was assessed. Treatment was given over a twelve-week period. Chlorpromazine was found to be significantly more effective than were any of the other three agents (Casey, Bennett, Lindley, Hollister, Gordon, and Springer, 1960).

A later study was conducted with hospitalized male schizophrenics who had been on maintenance dosages of either chlorpromazine or thioridazine. The subjects were randomly assigned to one of four groups: (1) continued at regular drug dosage, (2) reduced-intermittent drug, (3) regular placebo, and (4) intermittent placebo. At the end of the sixteen-week period, 45 per

cent of those in the two placebo groups, 15 per cent of those receiving reduced-intermittent medication, and 5 per cent of those continued at their usual dosage levels, had relapsed. Other patients in the placebo groups or the intermittent reduced dosage group had not relapsed but did show borderline adjustment. Therefore, discontinuation of chemotherapy was regarded as unfeasible because of the high probability of relapse. Similarly, reduced-intermittent administration did not seem practical (Caffey, Diamond, Frank, Grasberger, Herman, Klett, and Rothstein, 1964).

A disadvantage of both reserpine and chlorpromazine is that they sometimes cause side effects such as weakness, nausea, and low blood pressure. (Evarts and Butler, 1959). Chlorpromazine also produces an odd kind of restlessness known as *akathisia* and may cause excessive pigmentation in skin areas exposed to light, but only after many years of high dosage (Hamilton, 1965). In view of the undesirable side effects that may be produced by these and similar drugs, they should never be taken except under a physician's direction.

A number of the newer tranquilizing drugs have been widely used to reduce tension and anxiety among normal individuals as well as hospital patients. Of these, *meprobamate* (marketed as Miltown or Equanil) is perhaps the best known. Results have not been encouraging, however. For example, Miltown has been found to be no more effective than a placebo for abstinent alcoholics (Smith, Rutherford, and Fanning, 1957), for a group of patients suffering from varied symptoms of anxiety, muscle tension, and irritability (Koteen, 1957), and for a group of 130 male veterans treated as psychiatric outpatients (McNair, Goldstein, Lorr, Cibelli, and Roth, 1965).

Energizers. For depressed patients who are not helped by sedative drugs, *psychic energizers* are often administered. One of these, *imipramine*, showed its efficacy as an antidepressant in a comprehensive survey report based on the analysis of results in 103 published studies in which a total of 5864 patients were included.

Overall, imipramine and two other widely used antidepressants (amitriptyline and isocarboxazid) helped almost 65 per cent of the patients for whom they were

used. Three other commonly used energizers (phenelzine, malmide, and iproniazid) aided in 40 to 49 per cent of the cases in which they were used. The highest rate of improvement of all, however (72 per cent), was found for electroshock. Placebo controls were effective in only 23 per cent of the cases in which they were employed (Wechsler, Grosser, and Greenblatt, 1965).

An interesting sidelight of this survey was that drugs were less effective in the studies that used placebo controls than they were in the studies using no control group or comparing the effects of two drugs. The investigators attributed this difference, at least in part, to the fact that in the placebo-control studies the staff knew that half of the patients were receiving no drug and thus should show no change in behavior. In the other studies, by contrast, the physicians evaluating the progress knew that all the patients were receiving a drug of some kind and thus might be expected to show some change.

In another study of imipramine, a double-blind design was employed, using seven physicians and forty-two psychoneurotic patients. Three hypotheses were tested: (1) imipramine (Tofranil) is superior to a placebo for relieving symptoms in depressed psychoneurotic patients; (2) patients experience more relief with some doctors than with others; and (3) the relative effectiveness of imipramine and placebo depends upon the doctor administering the medications. The drugs were administered for a period of four weeks, and every two weeks each patient's condition was assessed. The investigators reported some support for the first hypothesis but little evidence to support the second and no evidence to support the third hypothesis (Uhlenhuth and Park, 1964).

Mescaline and lysergic acid diethylamide (LSD), discussed on page 491 as drugs which can *bring on* symptoms of mental disease, have also been used in therapy. One of the principal values of these drugs is that patients under their influence often regress to childhood behavior and feelings and are able to recall past events which may have helped cause their emotional disturbance.

In one study, 113 patients who had received LSD and mescaline after adequate preparation and in a supportive setting answered subjective questionnaires. Their answers

revealed a high frequency of claimed benefit, with few negative reactions and frequent feelings of greater insight into reality. Clinical data on seventy-four of the cases supported the claims made in the questionnaires. The total improvement rate was above 80 per cent (Savage, Savage, Fadiman, and Harman, 1964).

LSD has also been used effectively in group therapy, where, provided the setting is appropriate, it can enhance empathy and decrease defensiveness, helping the patient to communicate freely and reveal deep levels of feeling (Eisner, 1964).

However, even the trained psychotherapist must use caution in using the psychedelic drugs. In some patients they have led to prolonged psychotic reactions such as paranoia or severe depression (Cohen and Ditman, 1963).

Chemotherapy in perspective. Reserpine and chlorpromazine and their derivatives, plus certain anti-depressants, are often given chief credit for recent decreases in mental hospital population. The state of New York, for example, showed a 23 per cent increase in discharge rates in 1955, owing largely to the mass use of drugs (Brill and Patton, 1959). In 1959, for the third straight year, mental hospital populations in the country as a whole decreased (Deutsch, 1959).

However, the role of drugs in this decrease must be viewed with caution. Indeed, a study of a state hospital in Pennsylvania revealed a consistent decrease in proportion of patients retained continuously after admission even before drugs were being used to any great extent (Kramer, Goldstein, Israel, and Johnson, 1955). Obviously a number of other factors have been involved, among them improved methods of psychotherapy, changes in attitude on the part of hospital staffs, and proportion of patients treated as outpatients.

Nutrition in Therapy

In recent years psychologists have become increasingly aware of the role of an adequate diet in preventing and curing mental illness (Bell, 1958). As early as 1938, Vitamin B₁

deficiency was found to cause severe relapse among "recovered" patients at the Mayo Clinic (Williams, Mason, and Smith, 1939). Considerable decline occurred even among patients receiving the amount of thiamin (B_1) found in typical American diets (Williams, Mason, Smith, and Wilder, 1942). When half of these patients were given increased thiamin without their knowledge they showed considerable improvement. A little later, striking deterioration was found in the sense of well-being and adjustment of four normal young men subjected to restrictions of the B-complex vitamins (Brózek, Guetzkow, Keys, Cattell, Harrower, and Hathaway, 1946).

Inadequate amounts of other food elements also affect mental health. Calcium deficiency, for example, which often occurs during the rapid growth of adolescence, causes extreme irritability and instability (Planck, 1945).

The value of nutritional therapy for the elderly has been shown.

At a Veterans Administration hospital, 73 per cent of elderly psychotics given daily feedings of the food element glutamic acid showed improvement. Only 20 per cent of the untreated controls showed similar improvement (Finkle and Reyna, 1958).

As in the case of other forms of physical therapy, nutritional additives are held to be particularly effective when used in conjunction with psychotherapy.

One investigator, for example, reported success in fourteen out of fifteen cases of depression in which niacin was administered to patients receiving psychotherapy. In some patients there was improvement within twenty-four hours (Washburne, 1950).

In a recent study, one group of compulsive drinkers was given paraldehyde (a clear liquid of disagreeable taste used as a pain killer), glucose, and vitamin B therapy; while a comparable group was given intensive calcium therapy. It was found that those administered intensive calcium therapy required significantly fewer days of hospitalization. They soon became ambulatory and reached an early stage of recovery at which psychotherapy could be successfully started (O'Brien, 1964).

Unfortunately, not one of the studies cited above was conducted on a double-blind basis. Nor does a search of the literature reveal any such study in the area of nutritional effects. Actually, such a study would be almost impossible to conduct, since nutritional changes are slow in taking place and it would be very difficult to "fool people on their food" for a length of time sufficient to establish clear and lasting effects of diet in the absence of suggestion.

Psychosurgery

Among the most dramatic, most widely publicized, and most disappointing innovations in psychiatry have been the techniques of brain surgery used in the treatment of severe emotional disorders (Moniz, 1937; Freeman and Watts, 1942). The best-known form of psychosurgery is the *prefrontal lobotomy*, an operation in which the nerve fibers connecting the prefrontal lobes of the brain with the hypothalamus are severed.

Studies with animals have demonstrated that signs of anxiety arising from conflict may be removed by such an operation.

A monkey was taught to press a lever for food. Then, using an electric shock as the unconditioned stimulus, he was conditioned to respond to a light with increased blood flow in the aorta, faster heart rate, and heightened general activity. Following this, he ceased to press the lever for food after the light came on. When the prefrontal lobes were subsequently removed, the light no longer caused the vascular responses, and the monkey continued with great equanimity to press the lever for food (Smith and Nathan, 1965).

Clinical experience with human patients is consistent with results from such experiments with monkeys; it has been found that lobotomy does often diminish the emotional tone accompanying the individual's thoughts and memories. Thus, though psychosurgery is not thought to remove the sources of the patient's disturbance, it may release him from the emotional torment of disturbing ideas or hallucinations.

A major disadvantage of lobotomy is that it often results in profound personality changes, and the individual's emotional behavior may

become childish and lacking in depth. Although his memory may be unimpaired, he is apt to be uninterested in the past; he is concerned only with the present and has few goals which extend to even the immediate future. In general, the lobotomy patient may be described as lacking self-continuity; that is, he loses the feeling that he is the same person he was yesterday and will be tomorrow (Robinson and Freeman, 1955).

Many investigators have attempted to evaluate the psychological effects of psychosurgery through the use of tests, but the results have been largely inconclusive (Klebanoff, Singer, and Wilensky, 1954; Scherer, Klett, and Winne, 1957). Part of the difficulty has been that only advanced and apparently hopeless cases receive such operations and by this time the patient's effective intelligence is already much reduced by his mental illness, making any additional impairment after psychosurgery all the harder to detect. It has been established, however, that the psychological effects of psychosurgery are related to four factors: (1) length of the postoperative interval, (2) specific location in the brain of the surgical operation, (3) age of the patient, and (4) nature of the psychological test used to measure the effects (Smith, 1960).

The last point is borne out by an investigation in which factor-analyzed tests (p. 161)

representing a number of different aspects of intelligence were used.

A group of 150 lobotomized patients were compared with a control group of 150 schizophrenic patients who had not had psychosurgery. About half of the subjects also were given a general intelligence test. It was found that:

1. Marked differences were noted in the patterning of abilities shown by lobotomized and unlobotomized subjects. The pattern produced by the lobotomized group was more similar to that of normal persons than was the pattern produced by the unlobotomized patients.

2. This apparent improvement in pattern with lobotomy was accompanied by a consistent lowering of level of ability as measured by the Wechsler-Bellevue test of general intelligence. The lobotomized patients as compared with the controls had become less characteristically schizophrenic, but their intellectual powers had been reduced at the same time.

3. The factor-analyzed tests showed that this loss occurred mainly for tasks involving numerical operations, general reasoning, and social situations (de Mille, 1962).

Because psychosurgery, once performed, cannot be undone, and because its results are uncertain and insufficiently understood, it has been considered a method of last resort and is seldom used today.

THE BIOLOGIC APPROACH

Although many specific techniques of psychotherapy have been tried, some based on elaborate theories and others merely on practical experience, none has proved universally effective. In the face of this situation, most therapists have adopted an *eclectic* approach, not limiting themselves to any one procedure.

The ideal of the eclectic method was first advanced by Adolph Meyer, famed Johns Hopkins psychiatrist. Meyer's approach, which em-

phasizes the inseparability of *psychological* and the *biological* processes is known as *psychobiology*. The psychobiological approach aims at an understanding of all the factors—biological, psychological, and social—that are involved in a disorder. This eclectic philosophy leads to an *integrated* therapy in which various techniques are used in various combinations, depending on the individual case. Thus, a particular patient's program of treatment might include such tech-

THE COST OF INADEQUATE CARE

The uneconomical effects of false economy in services for mental patients were shown dramatically in Hastings, Nebraska, where a budget cut required that the staff of eleven physicians (including psychiatrists) be cut to only six. The chart compares the most visible human and financial costs for the two-year period preceding the cut and the two-year period following it.

PERIOD A—11 PHYSICIANS

84 PER CENT DISCHARGE RATE
(during first year after admission)

174 PROBABLE LIFE PATIENTS

\$4,872,000

(cost for 174 life patients at \$28,000 total per patient)

PERIOD B—6 PHYSICIANS

60 PER CENT DISCHARGE RATE
(during first year after admission)

421 PROBABLE LIFE PATIENTS

\$11,788,000

(cost for 421 life patients at \$28,000 total per patient)

Based on Cont, 1955

niques as free association, dream analysis, hypnosis, psychodrama, and any physical methods deemed necessary.

Institutional Care

The most complete program of integrated therapy is found in mental hospitals, where the patient receives treatment on a teamwork basis, with psychiatrists, psychologists, social workers, occupational therapists, and other specially trained personnel all contributing their diagnostic and therapeutic skills. The seriously disturbed patient can derive important benefits from living in an institution under close observation and protection. Under these conditions, he is relieved of difficult decisions and does not have to face many of the frustrations of normal living. Guilt feelings tend to be reduced in the presence of others who are having similar difficulties. Moreover, the patient is kept from endangering the safety—both physical and financial—of himself and those around him.

The institutional care and treatment of mentally ill individuals is a medical, financial, and social problem. Over one million patients are

treated annually in United States mental hospitals. In fact, about half of the hospital beds in the country are occupied by mental patients (National Institute of Mental Health, 1959). This is not because mental disorders are more prevalent than physical illnesses but because mental disease is generally more difficult to cure and to cope with at home and therefore requires hospitalization for a longer period of time.

The seriousness of the financial side of the problem is apparent when we learn that the total cost of mental illness in the United States, direct and indirect, is \$2.4 billion annually. This tremendous figure includes, of course, much more than mere hospitalization costs. Each of the fifty states operates mental hospitals, and in most states appropriations for the care and treatment of mental patients constitute one of the largest single items in the budget. Yet even in states with enthusiastic mental hygiene programs, facilities are inadequate. Almost all state hospitals are severely overcrowded. Furthermore, even though the number of psychologists and psychometrists has increased 574 per cent since 1945, there still are not enough trained psychiatrists, psychologists, and

other capable personnel for adequate care of the mentally ill. *

The patient in an institution has at his disposal various facilities besides those entailing purely medical treatment. *Occupational therapy*, for example, is provided in all good hospitals. This term refers simply to healing through keeping busy. Engaging in such simple, rhythmic activities as knitting, weaving, sewing, or polishing metal or furniture quiets the overactive patient. The depressed patient may be helped by stimulating activities in which there is a minimum of routine. Such activities as music, dramatics, creative art, and athletic contests—requiring close attention and rapid decisions—tend to keep the patient from thinking morbidly about himself and provide interesting and satisfying contacts with reality.

Life in a well-run institution follows as normal a pattern as the condition of each patient permits. The current trend is toward increasing freedom for patients to live normally and to govern themselves while in the hospital. Such arrangements, still in the experimental stage, have caused problems in some cases but have shown great therapeutic value in others. The Massachusetts Mental Health Center has increased its discharge rate from 35 per cent to 90 per cent since 1943, when it instituted a policy of trusting patients, discontinuing the use of locked doors and guards, and allowing patients to keep personal belongings (Cowen, 1960). In a private psychiatric hospital in Massachusetts, the Austen Riggs Center, patients and staff share administrative responsibility and authority.

Patients live in a building that resembles a country inn, each caring for his own room and deciding how to spend his leisure time. Normal social life, with no segregation by age, sex, or diagnosis, is part of hospital routine. Patients are required to perform a daily job as part of the work program and must answer to an agency of other patients and staff members if they fail to do so. A volunteer baby-sitting service organized by patients at a Fourth of July picnic has developed into a year-round nursery school for children of staff members and of local citizens, run by patients under the supervision of a professional nursery-school teacher. In general, the socializing process going on in this hospital community appears to give individual therapy a much better chance to succeed (Talbot and Miller, 1965).

The Coppice Hospital in Nottingham, England, has a social therapy center called "The Gateway" which is in a separate building and is administered entirely by an elected committee of patients. The medical and nursing staff attend committee sessions only by invitation and give advice on request but have no voting powers. Activities of the center are financed entirely by the patients and often involve projects including the townspeople. The center thus provides opportunities for patients to develop social responsiveness and responsibility as well as to have meaningful contact with the outside community. Problems and conflicts that arise in connection with the center often provide the content for group therapy sessions at the hospital (Woddis, 1960).

Sociotherapy

Other treatment procedures are often combined with various types of *sociotherapy*. This term refers primarily to the process of modifying the patient's environment in such a way that he will stand a good chance of making a successful adjustment. For example, sociotherapy for a disturbed child may involve treatment of his parents or even placement in a foster home. Sociotherapy is most often carried out by a psychiatric social worker, perhaps with the aid of welfare agencies or other community service agencies. The psychiatric social worker aids the family of a hospitalized person in various ways, helping them solve financial problems or even giving therapy to other family members in some cases. The importance of smoothing the way for the hospitalized individual's return to home life is also being recognized to a greater extent than ever before, and periodic follow-up visits by the psychiatric social worker are often an important aid in the readjustment of the discharged hospital patient to normal society.

Trends and Prospects

The Joint Commission (1961) recommended that no more mental hospitals with over 1000 beds be built; that acute cases be handled through facilities to be developed in

the patient's home community, without the delay of being put on a waiting list; and that, as soon as it became possible to do so, the existing large state institutions should be dismantled or converted to institutions for the care of chronic physical and mental patients. We have seen that a start has already been made through the Community Mental Health Centers Act to encourage the building of comprehensive community centers throughout the country. As such centers become more numerous and better equipped, it is hoped that more and more of the mentally ill can be cared for in their own communities and that the

large state mental hospitals will become a thing of the past. •

Already this approach has shown dramatic results in decreasing the number of those committed for long-term inpatient care. In Dutchess County, New York, for example, which had had one of the highest patient admission rates to the state hospital of any county in New York state, a special unit was established in 1960 to diagnose patients' needs more carefully, give intensive care to acute cases, and make arrangements for other types of care in the community for the less serious cases. It has been found that only 25 per cent of the pa-



● The aim of the new comprehensive community mental health centers is to provide a wide variety of services to people who need help, with a minimum of disruption of their normal routines and relationships. A homelike atmosphere, with as much privacy as possible, is provided for those who need inpatient care. Among the services for them as well as for those able to live at home are family group therapy (*upper left*), occupational therapy (*upper right*), and psychodrama (*lower left*). Patients well enough to do so have the satisfaction of usefulness in sharing household chores (*lower middle*). Foster homes or halfway houses with a family atmosphere often help complete the recovery of convalescent patients (*lower right*).

tients admitted under this arrangement need to be kept for twenty-four-hour inpatient care. The others are being treated through day care or through other community facilities.

Such comprehensive community centers have many advantages. With immediate care, adjusted to the need of the individual, overall treatment time can be greatly shortened and the patient and his family saved much trauma and grief. The stigma attached to being "sent away" is minimized or removed entirely, and the patient is spared the problems of adjusting to a lonely, far-away, impersonal institution and the equally difficult problem of coming back to his community after a long absence and trying to find his place in it again. Although current funds are concentrated on providing the first five of the services listed on page 506, it is hoped that ultimately the recommended aftercare and rehabilitation services will become a reality and that they will play as important a role in reducing readmission rates as the earlier phases of the program bid fair to do in reducing rates of original hospitalization and lessening needed treatment.

CHAPTER SUMMARY

In recent years attitudes toward the mentally ill and the conditions under which they are given treatment have greatly improved. In part this is due to the efforts of Clifford Beers, who had experienced ill treatment as a mental patient and who started the *mental health movement* in the United States shortly after 1900. The principal aims of the movement have been to create public awareness of the importance of preventing personality and behavior disorders from developing and to gain public recognition for psychotherapy as a method of treating such disorders. Mental health workers have put special emphasis on such *prophylactic* measures as establishing healthy parent-child relationships and developing adaptive techniques for handling everyday problems. *Epidemiological* studies have thrown considerable

light on factors contributing to the onset of mental illness. In recent years guidance facilities have grown rapidly, but the supply is still far short of the demand.

Psychotherapy, literally "mental treatment," has as its fundamental goal helping the individual to improve his modes of response to real-life situations. Psychotherapy may be practiced by *psychiatrists* (medical doctors who treat mental disorders), *neurologists* (doctors who specialize in organic disorders of the brain or nervous system), *clinical psychologists* (who have clinical training but no medical degree), *psychoanalysts* (who follow Freudian or neo-Freudian theory and practice), and *psychiatric social workers* (who study the social background of the patient).

Although their goal is the same, the methods of psychotherapy differ a great deal. The simplest method is *directive counseling*, in which the therapist supplies direct answers to problems presented by the patient. In *client-centered* or *nondirective* therapy, on the other hand, the therapist encourages the patient to "talk out" his own problems, a form of *catharsis*. The therapist's role is to lend emotional support and to reflect and clarify the client's feelings, providing a climate in which the client's own tendencies toward growth can operate.

Psychoanalytic therapy is an intensive and prolonged technique for exploring the patient's unconscious motivation in order to discover repressed conflicts, many of them originating in childhood. To bring these conflicts to consciousness so that the patient can solve them, psychoanalysts employ the techniques of *free association*, *dream analysis*, *analysis of resistances*, and *analysis of transference*. Recent advocates of psychoanalysis, sometimes called *neo-Freudians*, have emphasized that cultural factors as well as childhood experiences and biological cravings can precipitate mental disturbances. Another modification of psychoanalysis, *existential psychotherapy*, emphasizes the discovery of some early, basic choice made by the patient which has caused later maladjusted behavior. The existential school known as *logotherapy* focuses upon the need of the individual to see meaning in his life.

In contrast to the *insight therapies* discussed above, *action (behavior) therapies*, which are

gaining in support, deal much more directly with disturbed behavior, attempting to get rid of symptoms rather than being concerned with the "self" or the "personality." Most action therapists base their techniques upon conditioning theory. An important form of action therapy is *systematic desensitization*, a form of *reciprocal inhibition*. In *implosive therapy*, the patient imagines extremely frightening situations and as anxiety is extinguished for these, the effect generalizes to less frightening real-life situations. *Integrity therapy* emphasizes the need for greater fidelity to moral values. Evaluating the various forms of therapy has proved to be difficult and much more research is needed.

Certain physical methods of treatment are often used in addition to psychotherapy for severely disturbed patients. One is *shock therapy* (usually *electroconvulsive shock*). Prolonged *narcosis* may be used for severely agitated patients, but a more common form of narcosis is *narcoanalysis*, in which drugs are used to produce a semisleep in which the patient may be induced to talk freely about his feelings.

A number of drugs have been found helpful in the treatment of mental illness. However, since *placebos* are so often effective in treating a wide variety of illnesses, it is now recognized that the effectiveness of a drug over and above that of a placebo can be clearly established only in studies making use of a strict *double-blind* technique. *Reserpine*, *chlorpromazine*, and other *tranquilizing* drugs are valuable in calming excited patients and are often given credit for a considerable part of the recent decrease in the number of mental hospital patients. However, undesirable side effects may accompany the use of these drugs. *Psychic energizers* such as *imipramine* are used in the treatment of lethargic, depressed patients. *Mescaline* and *LSD*, which can also bring on symptoms of mental illness, have proved valuable in enabling patients to

regress and thus unearth childhood experiences which caused later emotional disturbances.

In recent years, psychologists have become increasingly aware of the role played by adequate *nutrition* in preventing and treating mental illness. Deficiencies in Vitamin B₁, calcium, and niacin have all been found to affect mental health, and glutamic acid has proved beneficial to elderly psychotic patients.

The most drastic form of therapy, used only in extreme cases when all other measures have failed, is *psychosurgery*, of which *prefrontal lobotomy* is the best-known form. Since psychosurgery has profound effects on the individual's personality and pattern of intellectual abilities, the trend in treating severe cases appears to be away from surgery and toward a greater use of drugs.

Most modern therapists use an *eclectic* approach, adapting various methods to the needs of the individual patient in order to provide an integrated therapy. For those who are seriously ill, *institutional care* offers the best opportunity for a program of integrated therapy. The provision of sufficient institutional care for mental patients is a serious medical, financial, and social problem in the United States today, since facilities are far from adequate to meet present needs. Institutions are increasing patients' freedom to live normally and to govern themselves as much as possible. *Sociotherapy*, modifying the patient's environment in such a way that he will stand a good chance of making a successful adjustment, is also being recognized as a promising approach. The most important trend today in the handling of the mentally ill is away from large state institutions and toward *comprehensive community centers* that can provide twenty-four-hour emergency service for acute cases, give various types and degrees of care according to individual needs, and will ultimately be able to offer aftercare and rehabilitation facilities.

Part Six

Up to this point we have, for the most part, been studying the individual human being—how he develops and changes under the influence of heredity and environment, how his abilities and other personality traits are measured, how he senses, perceives, and thinks, what propels him to action, and how he may react to frustration and stress. These processes are the classic subject matter of psychology and, as a result, are the processes which have been studied most thoroughly by psychologists. In the last twenty-five years, however, there has been increasing realization that not all of man's behavior can be understood or explained by examining the individual in isolation from the group of which he is a part.

Because research into group processes has gone on only a relatively short time, there are many gaps in our knowledge, and studies often give contradictory results. As methods of research are further refined and controls better worked out, these inconsistencies will undoubtedly be explained, and the findings will be better integrated than they are today.

A question that arises early in the study of group processes concerns the value of competition. Although competition plays a prominent role in American life, we have no scientific proof that it is always the best incentive for organized group activity. The problem of leadership is also important in groups. What are the characteristics of a good leader, how much power should he have, to what extent should the group set its own goals—all these are involved in the broad problem of group leadership. We

shall also look at what happens when certain individuals fail to adjust normally to the demands of group living and turn to crime and delinquency.

Perhaps man's greatest asset is his ability to communicate the products of his learning to other people. Communication enables many persons to benefit from the experience of one. Thus each generation does not have to "start from scratch," but is able to start where its ancestors left off—and thus to avoid many of the errors of the past. Communication is an indispensable process underlying the organization and functioning of any group, whether it be as small as a two-man team or as large as a great nation; for in order for people to strive toward the same goal, they must operate on the basis of common information.

Almost every moment of our waking day we are bombarded with ideas that someone else would like us to accept and act upon—via television, radio, billboards, newspapers, magazines, books, and so on. Mass communication in our day is not only big business; it has become both an art and a science and is now an essential part of the present-day American scene. We need to know how it operates, how effective it is, and just what its effects are. We shall examine both the methods used in the mass media and the methods used by psychologists to study the effects of the mass media on people's attitudes and behavior. No area of psychological knowledge has a greater potential for good—or evil—than the knowledge of how to change people's attitudes.

Chapter 15

Outline

COMPETITION AND COOPERATION

IS THERE AN "INSTINCT" OF COMPETITION?
EFFECTS OF COMPETITION AND COOPERATION
PLANNING FOR EFFECTIVE COMPETITION

INDIVIDUAL VS. GROUP ACTION

SOCIAL FACILITATION
SOCIAL INTERACTION
THE "RISKY SHIFT"

FACTORS IN SMALL GROUP FUNCTIONING

COMPOSITION OF THE GROUP
PATTERNS OF COMMUNICATION AND ORGANIZATION
THE EFFECTS OF STATUS
GROUP PARTICIPATION IN DECISION MAKING
GROUP PRESSURES ON THE INDIVIDUAL

EFFECTIVE LEADERSHIP

RESPONSIBILITIES OF A LEADER
STYLES OF LEADERSHIP
GROUP REACTIONS TO STYLES OF LEADERSHIP
WHAT MAKES A GOOD LEADER?
TRAINING FOR LEADERSHIP

ILLEGAL BEHAVIOR

FACTORS IN DELINQUENCY
RECENT IMPROVEMENTS IN TREATMENT
APPROACHES TO CRIME PREVENTION

Chapter 15 The Individual and the Group

Thus far we have examined the psychology of individuals—how they differ in aptitudes and temperament; how they learn, perceive, and think; and what motivates them to action. What happens when a person's environment includes the behavior of other persons? People come in contact with each other in many spheres of life—home, school, church, business, politics, to mention but a few. Clearly, the analysis of social influences on the individual is one of our most important tasks.

This is an area to which three disciplines contribute: experimental psychology, sociology, and anthropology. Generally speaking, anthropology, being basically a descriptive science, can merely formulate hypotheses suggested by differences in the behavior of people under different cultures. Sociology studies mainly the growth of institutions which influence the behavior of groups. Experimental psychology generally studies variables apart from their social stimulus value. Social psychology brings the three together, stressing the effect of these social and cultural variables on the behavior of the individual.

It has often been said that competition is the very basis of the American way of life. The Russian Communists hold a contrary view of the virtues of competition and have at times used great force to eliminate competition as it is seen in American business. The extermination of seven million small farmers (*kulaks*) by Stalin, in the 1930's, was seen by the party as a charitable act to bring about communistic togetherness, uncontaminated by capitalistic rivalry. What are the facts about the effects of competition? Do people work best when competing as individuals or when cooperating in organized groups? Does competition have undesirable effects on children? On adults?

Is it better for people to be "told what to do" by an all-powerful leader who can reward or

punish as he sees fit, or should the group determine its own goals and standards? What patterns of communication within a group are most effective? Are leaders born or made? What causes one person to emerge as a leader while others remain content to follow? What are the responsibilities of a leader to his group? These are a few of the questions which a social psychologist would raise; they will be taken up in this chapter.

COMPETITION AND COOPERATION

Many of the tasks that confront man in daily living can be accomplished alone or in groups. They can be done by individuals competing with each other, or they can be done by persons cooperating. Many people maintain that individuals in a group will *naturally* compete and should be encouraged to do so—that children will learn more, that business will thrive, and that nations will become great under the incentive of competition. Those opposed to this view hold that competition is too often destructive, that the most lasting and constructive accomplishments are possible through cooperative activity. Clearly, two questions are involved in this issue: (1) Is there an "instinct" of competition? (2) What are the effects of competition and of cooperation? Let us examine the evidence.

Is There an "Instinct" of Competition?

The question of whether the urge to compete is inborn has profound social significance.

In the United States, with its tradition of individualism, competition continues all through life. Often we are made to feel that we should do better than anyone else: be first in the class, captain of the team, a member of the "best" fraternity, the boyfriend of the most popular girl on campus, the owner of the biggest house and the newest car on the block. It is obviously impossible for everyone to reach all—or even one—of these goals.

Studies of various cultures have fairly well convinced anthropologists that competitiveness is learned rather than inborn. This conclusion is supported, for example, by studies of the Hopi Indians of our Southwest and the Kwakiutl Indians of Vancouver Island. These two groups lived under strikingly different environmental conditions and developed equally striking differences in their cultures as regards competition and status-seeking.



▲ One chimpanzee alone is not strong enough to haul in the box of food attached to the ropes; this pair quickly learned the advantages of cooperation.

Cooperation was highly valued in the Hopi culture, where farming was the principal means of livelihood and where cooperative irrigation projects were necessary to farming. Competition and aggression, on the other hand, were consistently discouraged. Children were taught not to seek the limelight, and the person who wanted to win or become outstanding in any way often became an object of ridicule (Goldfrank, 1945).

The situation among the Kwakiutl was very different. These Indians lived under conditions of relative economic plenty but engaged in intense and bitter rivalries. Personal wars were waged through *potlatches*—feasts at which large quantities of food and other property were given away or even destroyed. The individual's prestige was measured in terms of the amount of goods he gave away. Gifts were used as weapons, since the receiver of a gift at a *potlatch* was obliged to return a bigger one or be disgraced. Life was a constant competitive battle, always threatening defeat and dishonor (Benedict, 1934; Goldman, 1937).

Even in cultures where cooperation or competition is strongly encouraged, individual or subgroup motivation may differ greatly from the cultural norm. This has clearly been brought out in a study of the Hopi.

To see if Hopi children would demonstrate competitive responses in situations where their actions were unknown to the rest of the group, the investigator used two tests. In the first, subjects were asked to make marks in circles and to traverse printed mazes with their eyes closed; but they were not closely watched, so that they could easily cheat. Maximum honest scores had been established by using blindfolded subjects; scores in excess of these were taken as indications of cheating. It was found that 40 per cent of the Hopi children cheated—a lower percentage than among a control group of white children but enough to suggest that some of them were trying to make better scores than their fellows.

In a more conclusive part of the study, the children were asked a number of preference questions, including whether they would prefer to make the best grades in the class or make the same grades as most of the others; whether they would rather run a race for a prize or just for fun; whether they would like to be the tallest in their class or the same height as most of the rest; and so on. Replies showed that 60 per cent of the boys and 79 per cent of the girls preferred to make the best grades, and that 72 per cent of the boys and 63 per cent of the girls

preferred to run a race for a prize. On this test, in fact, the Hopi gave more answers indicating competitiveness than did the white children. Evidently, individual motivations were partly competitive in spite of the prevailing cultural pattern (Dennis, 1955).

On the basis of evidence such as that just presented, psychologists agree that all-out competitiveness is not an inborn trait. They maintain that children can be taught to compete or to cooperate or to achieve a balance between the two. This conclusion has been supported by animal experiments and by cultural studies.

In one study, a box containing food was placed outside the cage of two chimpanzees. The box could be hauled in by a rope but was too heavy for one animal to pull alone. The two chimpanzees soon learned to pull together to bring the food within reach of the cage. The chimps learned to help each other even when one of them was not hungry (Crawford, 1937).

Even members of species usually hostile to each other can learn to cooperate under conditions where they both benefit from cooperation.

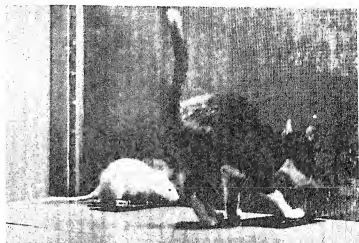
A three-week-old kitten and a young rat learned to eat and live together in the same cage. Then a screen was placed between the animals and their food; it would open only when both animals pressed levers simultaneously. Quite by accident, when the cat was playing with the rat's tail, both levers were pressed and they had access to the food. The next time the cat wanted food, it again played with the rat's tail, but with no luck. But soon, when the cat had its paw on a lever, the rat ran over and pressed the other lever. The cat caught on quickly, and before long the two cooperated easily in the task of obtaining food (*Science News Letter*, 1950).

Experiments such as this demonstrate the flexibility of some behavior patterns long assumed to be instinctive and unchangeable.

Effects of Competition and Cooperation

In many areas of life the spirit of competition is mixed with that of cooperation. Businesses, for example, compete with one another for customers but cooperate through chambers of commerce and other organizations that are

In this experiment the cat and the rat learned to obtain food by pressing levers simultaneously to raise the screen that separated them from the food.



Courtesy of Professor Loh Seng Tsi

intended to promote their common interests. Boys compete for a place on the football or basketball squad but work cooperatively for the success of the team and the school. These observations suggest several points for consideration. How do competition and cooperation affect the kind and amount of work accomplished by individuals and by the group as a whole? How do they affect the character of the group? What are the effects of competition and cooperation on the personalities of the individuals who experience them?

Competition as an incentive. Individual competition has been used extensively in schools to stimulate students to greater effort. Gold stars, prizes, or special privileges often go to those who have done particularly well in their studies. Many children take such honors very seriously and strive to be included in the select list.

But is competition really effective as an incentive to learn? Various studies have investigated this question. Some investigators have concluded that classroom groups perform most effectively under *cooperative* conditions (Deutsch, 1949; French, 1951); others have found that *competitive* conditions improve performance (Hurlock, 1927; Leuba, 1933). One important factor seems to be the kind of competition used; another is the nature of the social situation.

One early investigation compared individual and group competition as factors motivating schoolwork. Simple addition was selected as the task. Of the children studied, 65 per cent showed greater speed in doing the problems when working for themselves, whereas 35 per cent showed greater speed when working for the group. Boys persisted longer than girls in working for the group; girls persisted longer than boys in working for self.

On the basis of this experiment and others, the investigator placed the various competitive situations in the following order of strengths as motivating conditions: (1) boys working against girls as individuals, (2) working for self, (3) working for a team, (4) working in partnership, (5) working for the classroom as a whole, (6) working for a group picked arbitrarily by an outsider (Maller, 1929).

Another early study found that with simple tasks most individuals produced a *greater quantity* of work in a competitive situation but that it was of *poorer quality* (Whittemore, 1924). More favorable results were obtained in a more recent industrial program where adult subjects employed in maintenance work were trained to make relay adjustments under competitive conditions.

The subjects had had varying degrees of experience in relay adjustment but no formal training for it. Each class consisted of sixteen men arranged in two rows of eight each, and it was announced that the rows would compete with each other. Instructions consisted of a three- to four-hour demonstration at the beginning of each week of the class. The rest of the time was spent in making practice adjustments. Each adjustment was graded by a demonstrator, and a group score was computed for each row. Individual scores were not announced. Results showed that the men in these classes, as compared to others in which no competition was introduced, did a significantly greater quantity of work in the same amount of time and that the quality was about the same as in noncompetitive groups (Williams, 1956).

Differential rewarding for output is the very essence of competition. Yet a survey of published literature on this subject has found that although individuals working alone are more productive when rewarded on their individual merits, group rewards are superior when each

member's task is dependent on the production of the others. Here, since all in a very real sense are responsible for the finished product, differential rewarding has a divisive effect and decreases the productivity of the group (Miller and Hamblin, 1963).

Effects of competition on the competitors. Although competition often increases productivity, it sometimes has unfortunate effects upon the individuals involved. Too great an emphasis on competition tends to make both children and adults want to win at any price—even through dishonesty. There is an even greater danger that preoccupation with the competitive aspects of the school situation will blind many students to the less immediate but more fundamental goals of education—the acquisition of knowledge and skills.

Another important consideration is the effect of defeat on the losers. If there are to be winners, there must always be losers. Does the person who loses consistently continue to work hard even though he knows that somebody else will get the prize? As we saw in chapter 7, it does not work out this way: discouragement or failure tends to reduce one's later efforts. People tend to protect themselves from the discomfort of repeated failure in competitive situations by lowering their "level of aspiration" and investing their efforts in more promising directions.

Each member of a large class of students was asked to state the grade he expected to receive on an important test to be held the next day. Exactly half of the students reached or surpassed their level of aspiration. When the second important test came along, the students were again asked to indicate the grade they expected to receive. About two thirds of both groups indicated the same expectation as before. But a third of the disappointed group lowered their expectations whereas a third of the successful group raised their expectations. The expectations indicated by students in the two groups at the time of the second test are shown in the table below (Pennington, 1940).

	Lower	Same	Higher
Successful half	2%	62%	36%
Unsuccessful half	34	66	—

The effects of cooperation and competition upon the behavior of individuals in small groups were compared in an experiment in which subjects were permitted to communicate only during three note-writing periods.

At the beginning of the experiment, some of the subjects received "planted" messages that made them regard the experiment as a cooperative enterprise; the rest of the subjects received messages that made it appear competitive. Results showed that cooperative subjects showed more cohesive behavior, made more attempts to influence other members, exerted more pressure toward uniformity, and sent more relevant communications than did competitive subjects. Most of their communications concerned information and opinion about the experiment. Cooperative subjects also received more communications. The competitive subjects sent more messages expressing tension and antagonism. In general, the experiment indicated that an individual's frame of reference will determine what he expects of others—that is, a person who perceives the situation as cooperative will tend to act cooperatively and to expect cooperative behavior from others, whereas individuals who perceive the situation as competitive tend to be competitive and to expect competitive behavior from one another (Grossack, 1954).

Competition between groups typically produces identification with and bias toward one's own group, with an accompanying tendency to downgrade other groups. This process is observed not only among the active participants but also among nonparticipating members.

One hundred college students were divided into twenty-two groups of three to six members. The groups worked in pairs, one group at each end of the room. The experimenter told them he was interested in watching groups work as efficiently and constructively as possible, but tried to say nothing which would foster a spirit of active competition between the two groups. After a five-minute period used to organize and choose a group name, the subjects filled out a morale survey to provide a base-line measure of attraction to the group. Each of the two groups then performed three tasks, one member of each group (a different member for each task) being sent out of the room while the others worked. For each task the instructions were to produce as "original, creative, and symbolic" a product as possible in the time allowed. The first task was to make something from a set

of interlocking toys. The second was to produce a sketch of a proposed plan for a housing development. The third task consisted of writing a fable with a moral to it. At the end of each fifteen-minute work period, the two productions were displayed on a table in the center of the room. Every individual, including the two nonparticipants, rated both products on a nine-point scale from "terrible" to "excellent" and wrote a brief explanation of his ratings.

Differences in ratings in favor of the subject's own group's products occurred 2.5 times as frequently as differences in favor of the other group. This held true for nonparticipants, who had had no active part in producing or creating the products, showing that attraction to the group itself was responsible for most of the bias. Members showed considerable objectivity in rating products which obviously differed in quality; however, even then the group which had produced the poorer product described the differences in quality as smaller than did members of the other group.

A second morale survey was then taken, each subject rating both his own and the other group on quality of work, efficiency, group cohesion, motivation, freedom of participation, etc. On this survey, nineteen of the twenty-two groups indicated that they preferred their own group to the other. Members of fifteen groups indicated more favorable feelings toward their group than in the initial morale survey, with six showing less favorable feelings and the remaining group no change (Ferguson and Kelley, 1964).

Competition and hostility. Intense competition between individuals or groups can lead to hostility and a tendency to impute bad faith and shady tactics to the other side, especially when one is losing.

In an ingenious study in a camp situation, pictured on page 549, friction was generated between two experimentally created groups and was later overcome as the groups worked toward common goals. The subjects were twenty-two normal boys about eleven years of age, with homogeneous backgrounds, who were divided into two comparable groups on the basis of such factors as size and various abilities. Before arriving at the camp the boys did not know each other, and they remained unaware that an experiment was taking place.

To cement the boys into true groups, the experimenters put the groups in different bunkhouses and kept them separate for daily activities, introducing several

problems that required group solution, such as carrying canoes from the bunkhouses across rough terrain to the lake and fixing meals from unprepared food. By the end of this part of the experiment, the two groups had acquired definite group structures, including leaders, names for themselves (Rattlers and Eagles), nicknames, private signals, cooperative patterns within the group, and individual symbols of identification (flags and signs set on places and facilities designated as "ours"). This part of the experiment supported the hypothesis that a definite group structure will result when individuals are placed in situations involving appealing goals and requiring cooperative effort for the attainment of these goals and that as the group structure is formed, norms regulating behavior and group activities of the individuals will become standardized.

Next, rivalry between the groups was stimulated by a series of competitive events. As predicted, this increased in-group solidarity and produced unfavorable stereotypes of the out-group and its members. In-group democracy and cooperation did not extend to the out-group. After losing a tug-of-war, the Eagles burned the Rattlers' flag. The Rattlers retaliated, and a series of bunkhouse raids ensued, accompanied by name calling, fist fighting, and other expressions of hostility. During the conflict, a physically daring leader emerged to replace the less aggressive boy who had led the Eagles, indicating that relations with other groups will cause changes within a group.

One other interesting fact concerned a second tug-of-war. The Eagles used the strategy of sitting down and digging their heels into the ground. After losing ground, the Rattlers resorted to the same tactics. Finally the contest was called a tie. When asked the next day how long the contest had lasted after both groups had sat down and dug in (actually forty-eight minutes), the nearly victorious Eagles gave their estimates in minutes, ranging from twenty-two and a half to forty-five, while the Rattlers, who had accepted the outcome with relief, gave theirs in hours—from one to three and a half. The Rattlers, furthermore, were unable to distinguish between the length of time devoted to the whole event and that taken up after both groups sat down.

An attempt was then made to break down the hostility and induce the two groups to cooperate with each other. First, the rival groups were brought into close contact in pleasant activities—such as eating and shooting off firecrackers. The groups refused to intermingle, however, and the activities merely provided them with further opportunities for such expressions of hostility as throwing mashed potatoes and exchanging invective,

indicating that intergroup contact does not in itself decrease tension. The same thing had happened in an earlier study, in which several other methods had also been found unsuccessful, such as promptly stopping fights and separating the combatants, exhorting them to forget their grievances and cooperate in camp-wide activities, and even getting the boys in one group to admit part of the fault and try to make amends. An emissary sent by one group on a "peace mission" to the other group's cabin had been chased away in a hail of green apples.

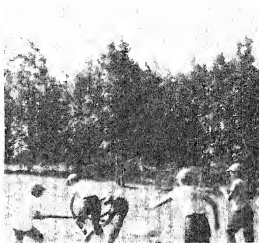
In the present study a more successful way was found. Situations were contrived to bring about interaction of the groups to achieve superordinate goals—that is, important goals which could not be achieved without the combined efforts of both groups. In one problem situation the camp water supply was mysteriously cut off and all the boys cooperated in locating the trouble. For a time friction continued, however; after cooperating to procure a film, for example, the boys still sat primarily with their own groups while the film was being shown.

The most striking episode in this period was one in which the tug-of-war rope, formerly the central object in a most antagonistic situation, served as a tool. On an overnight trip, a truck which was to bring their food "stalled," and the boys hit upon the idea of using the rope to pull the vehicle. After looping the rope through the bumper, the two groups pulled on different ends; but the next day, when the truck "stalled" again, members of the two groups intermingled on the two lines, obliterating group divisions.

Further evidence of the change in the boys' attitudes was obtained from sociometric choices made at the end of the period of intense competition and again at the close of the experiment. Rattlers' choices of Eagles as friends went up from 6.4 to 36.4 per cent of their total friendship choice. Eagles' choices of Rattlers went up from 7.5 to 23.2 per cent. The boys were also asked to rate each other on six characteristics designed to bring out the presence of stereotyped images. During the period of antagonism, Eagles received few favorable ratings from Rattlers, and Rattlers few from Eagles; but at the close of the experiment there was no significant difference in the ratings of in-group and out-group members (Sherif and Sherif, 1956).

This study has many implications for the problem of bitterness between national groups and between antagonistic groups within our own society.

At the beginning of the experiment a cooperative atmosphere developed rapidly within each group; here the Eagles are shown preparing a meal (top, left) and the Rattlers work together carrying canoes to the lake (top, center). During the second stage of the experiment, intergroup competition was fostered, and the rivalry soon became intense. Raids and counterraid took place, with flags and even articles of clothing being carried off as trophies (top, right). A tug-of-war ended in a complete impasse (bottom, left) when Rattlers adopted the Eagle strategy of sitting down and "digging in." In the final stage of the experiment, intergroup cooperation was brought about by the creation of situations that could be worked out only by cooperative means, such as searching for the source of trouble in the camp water supply (bottom, center) or pulling a "stalled" truck (bottom, right).



Planning for Effective Competition

There are several plans for utilizing the incentive value of competitive conditions and at the same time minimizing or altogether eliminating the undesirable effects of competition. Most of them are based on classroom experience, but often they can be adapted to other situations.

One plan is to rank the members of the group, on the basis of their initial performance, from best to poorest. Rewards are then made on the basis of greatest improvement in rank. This scheme affords ample opportunity for the poorer performers to share in the pleasures of winning. At the same time it stimulates the better performers to improve their performance rather than "rest on their laurels." It does nothing for the best person in the group, however, until he falls down a rank or two. Furthermore, this plan still creates a loser for every winner. A similar plan without this aspect is to have individuals compete against their own records, irrespective of rank in the group—to try to improve the level of their own performance however good or poor it has been.

Another widely used scheme is that of dividing the group into various subgroups made up of individuals who are about evenly matched in ability. This arrangement actually tends to strengthen the incentive value of competition, for people are most strongly motivated when they know they have a chance to win—or to lose. At the same time, because success will be distributed throughout the group over a period of time, the undesirable effects of competition on interpersonal relationships will largely be averted.

Ideally, those who compete with each other should be of similar enough ability that they all have a chance to win. If attainable goals are set up, an individual does not feel so unsure of himself that he must compete excessively. Much of the emotional tension caused by competition can be eliminated if a high value is put on fairness and good sportsmanship. The person who feels he must win at any price and hence resorts to "cutthroat" competition may tend to feel guilt over winning and inferiority over losing. Or an individual may feel that by succeeding he will lose popularity.

Often teams can be used to "distribute the risk" in a competitive situation—as is done, for example, in team sports and in the formation of sales teams. The frustration of failure is lessened when there are others to share it with, and the joys of victory are increased correspondingly.

Unfortunately, these suggestions can be followed only in relatively simple work, study, and play situations in which the goal is readily discernible and in which progress can be measured objectively. Many of our relationships with other people depend upon our ability to adjust to competitive situations that cannot be controlled by formal arrangements and rules for "fair" competition.

Intergroup rivalries growing out of intense competition are hard to keep within bounds. Exuberance and school spirit in connection with school athletic contests sometimes lead to property damage, competition between rival gangs is a large factor in producing aggressive, antisocial behavior among their members, and of course the rivalries of national groups lead to the even more dangerous consequences of war. Leaders of organized groups within a society can often do much to keep competition from becoming too bloodthirsty and can also deliberately foster an admiration and appreciation of the abilities of other groups as well as an appreciation of diversity itself. Open communication and working together toward common goals would seem to be the most promising way of breaking down the different valuations of "us" and "them" that tend to grow up under competitive conditions.¹

There are some indications today that the pattern of our culture is swinging away from the extreme competitiveness that characterized our young, expanding, individualistic economy of a hundred years ago. It is still a very real thing, however, to the student who wants to get grades good enough to gain admission to medical school or some other program of graduate study—or to stay out of the army. The problem of reducing harmful competition—or of using competition more effectively—will not be easily solved, for it involves our whole social tradition.

1. Fostering cooperation and communication in international relations is discussed in the article by Herbert C. Kelman in Reference Manual Section B.

INDIVIDUAL vs. GROUP ACTION

Although it is sometimes true that "too many cooks spoil the broth," there is no doubt that in certain situations human goals can be achieved more efficiently by cooperative effort than by individual endeavor. This fact, which most people will readily accept on the basis of their personal experience, is supported by many lines of experimental evidence. There are, however, some situations in which the individual produces more when working by himself.

Social Facilitation

The earliest studies of individual as compared with group productivity were simply studies of whether the presence of other people improved the performance of individuals—whether there was *social facilitation* as a result, presumably, of the additional sensory stimulation (Allport, 1920). Findings agreed that individuals worked faster in the presence of others but were contradictory about the quality of the work produced when others were around. Individual differences are important in this regard. Many college students report that they can study better in the reading room of the library where other students are also studying but with no direct communication among them. Others report getting better results from solitary efforts.

Social Interaction

Groups and individuals working alone have been compared in their performance on problem-solving tasks where the opportunity to pool their skills in a joint effort makes interaction among the members an important feature of the group situation.

One study involved problems similar to the game of "Twenty Questions." In this game the participants are asked to guess the identity of some person or object.

They are told only whether it is animal, vegetable, or mineral and are allowed to ask twenty questions, each of which can be answered "Yes" or "No." Because one starts with a somewhat vague problem, obtains information, uses it to formulate new questions, and so on until the problem is solved, this type of problem is similar to many we meet in everyday life. In this particular study some individuals worked alone at solving the problems, some worked in groups of two, and others worked in groups of four. Since pretesting had shown that allowing only the traditional twenty questions resulted in a high proportion of failures, groups were permitted to ask thirty questions before being charged with a failure.

Group performances were superior to individual performances with regard to number of questions needed, number of failures, and elapsed time per problem. Groups of four were superior to groups of two only in the number of successful solutions. In terms of man-minutes required for solution, the performance of individuals was superior to that of groups, and the groups of two were superior to the groups of four (Taylor and Faust, 1952).

In another study, in which a high degree of inference and judgment was called for, group solutions were better than the average individual solution but not better than the best individual solution (Hall, Mouton, and Blake, 1963).

In creative thinking, group participation has not been found to be superior to individual effort.

In an experiment designed to compare the efficiency of group versus individual effort among college students, twelve four-man groups and forty-eight individuals working alone followed the rules of brainstorming (see page 368) in attacking the same three problems in the same order. When the experiment was completed, the forty-eight individual subjects were randomly divided into twelve nominal groups of four men each. The performance of each nominal group was then scored as though its members had actually worked together. It was reasoned that the achievement of the nominal groups would provide a measure of the performance to

be expected if group participation neither facilitates nor inhibits creative thinking.

The performance of the twelve actual groups was found to be markedly inferior to that of the twelve nominal groups in three important ways: (1) mean total number of ideas produced, (2) mean number of unique ideas produced, and (3) quality of ideas produced. Apparently group participation may inhibit creative thinking when the brainstorming technique is used (Taylor, Berry, and Block, 1958).

Another study, using research scientists and advertising personnel as subjects, has verified these results. Even under conditions designed to ensure a minimum of criticism, group participation is apparently accompanied by certain inhibitory influences. It was found, however, that the individual brainstorming sessions could be made even more effective if they were preceded by a group "warm-up" session (Dunnette, Campbell, and Jaastad, 1963).

The "Risky Shift"

An interesting phenomenon which often occurs in groups of people is the *risky shift*. This is the tendency for a group to be willing to take greater risks than its individual members would take on their own.

In a recent study of this group effect, 360 college students (180 men and 180 women) met in five-member groups to discuss such questions as whether a heart patient should risk an operation which might cure him or resign himself to a restricted life and whether a low-ranking chess player should stake his reputation on a risky play in a tournament. Three experimental conditions were employed. In one, the group discussed the situation and arrived at a consensus. In the second, no discussion was permitted, but each member in turn announced his opinion until all decisions were the same. In the third condition, group discussion was held but no attempt was made to reach a common decision; members recorded their decisions privately.

In groups which had engaged in discussion, whether or not they had come to an agreement, the risky shift occurred. In contrast, the opinions of the group which had not discussed the problem showed an averaging effect but did not shift in the direction of taking risks. Thus the process of group discussion itself, rather than information about the opinions of other members (which was present in all groups) or pressure to conform (which could not have been present in the third group) was found to be the deciding factor in the risky shift. The investigators attributed this to the fact that during discussion group members come to feel that the responsibility for possible failure of the risky course of action is spread among all members of the group. Thus they feel free to take bigger risks than if they were assuming full responsibility as individuals (Wallach and Kogan, 1965).

From the many studies of factors that make group activity effective or ineffective, several principles have emerged. The composition of the group, patterns of communication and organization, differences in status, group participation in decision making, and group pressures on the individual will be discussed here as examples of factors that have been investigated. This is far from a complete list but will give some idea of the complexity and interdependence of the variables in this field of re-

search and the methods of attack that have been used.

Composition of the Group

How much alike should group members be? Clearly, for some kinds of tasks a variety of abilities will be an asset; in fact, in some cases the greater output of a group over individual work-

ing independently on the same task is made possible by the fact that different parts of the job can be handled by different individuals working simultaneously. In addition, different points of view and different background experience among the members can make it more likely that one member's errors will be detected and corrected by another. On the other hand, individuals who are too different may have trouble learning to work together, especially on tasks requiring very close coordination.

One study tested the hypothesis that just as a flexible individual, being capable of moving mentally in a number of directions, can solve problems more effectively than can a rigid "one-track" individual, a group whose members are widely different in personality structure will have more "directions" available and thus should be able to arrive at better solutions than a group with members of similar personalities. The subjects, 175 college students in a course in the psychology of human relations, were divided into four-person groups on the basis of scores made on the Guilford-Zimmerman Temperament Survey. Homogeneous groups were composed of individuals with high correlations between their scores on the test; nonhomogeneous groups contained individuals whose scores had approximately zero correlation.

The members of each group were told that they were a guerrilla team which had just blown up an enemy bridge and must get back to their own lines. In order to meet the truck which was to carry them back to the base, they would have to cross a heavily mined road. Scrap materials such as ropes, lumber, and so on were lying nearby. Their problem was to determine the best way to cross the road quickly and safely without leaving traces of having crossed.

As predicted, the nonhomogeneous groups were highly superior to the homogeneous in the quality of the solutions produced. The subjects were asked to indicate whether they were satisfied with their group's solution to the problem. Again as predicted, the homogeneous groups were nearly all satisfied with the solutions, in spite of their relatively poor quality in many cases. More disagreement with group solutions was expressed by members of nonhomogeneous groups despite the better quality of their solutions (Hoffman, 1959).

From a series of experiments investigating the relationship between member heterogeneity and creativity of two-person teams (dyads), the following conclusions have been drawn:

(a) Dyads heterogeneous in attitudes and homogeneous in abilities are more creative than those which are heterogeneous or homogeneous in both. (b) Training in the other member's point of view improves creativity of heterogeneous dyads. (c) Low interpersonal attraction is negatively correlated with creativity. (d) The more creative each member of a dyad is, the higher the creativity of the two-person team (Triandis, Hall, and Ewen, 1965). On the other hand, in performing simple tasks requiring little or no creative thought, homogeneous groups are likely to be more productive (Weist, Porter, and Ghiselli, 1961).

Where a great deal of cooperation among members is required in performing an actual task, especially where a chain of acts is required of the group and each individual provides a separate link, a homogeneous group is likely to be more efficient. One extremely slow member, for example, can keep the whole group from progressing at a satisfactory rate, as shown in a group maze study in which groups had to master a complex interlocking system of levers (McCurdy and Lambert, 1952).

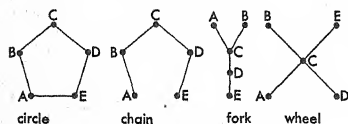
Although a recalcitrant member can hinder the progress of a discussion group, arriving at a decision too quickly on the basis of opinions already held is unwise in some situations. A heterogeneous group is more likely to discuss the problem adequately and hence arrive at a more satisfactory solution. Thus there is an "optimum mix" of personal characteristics for any given group project (Bass, 1965). The optimum mix for simple, routine tasks includes fairly similar kinds of individuals, while for complex tasks requiring creativity the mix should be more diversified.

Patterns of Communication and Organization

In cooperative activity, adequate feedback is especially important. The ability of an individual to integrate his work successfully with that of other group members depends on his obtaining information about the activities of the others and the overall progress the group is making. The extent to which communication is free or restricted has a definite influence both on the

effectiveness with which a group can organize and carry out a program of cooperative effort and on the morale of the individual members.

In one study the subjects were divided into four groups of five people each. The subjects in each group were seated around a table, separated from each other by partitions containing slots through which they could pass messages to each other. From a set of six symbols, each subject was given five. The symbols were distributed in such a way that only one of the six symbols was held in common by all five members of the group. The task was for the entire group to discover as rapidly as possible, by passing notes through the slots in the partitions, which symbol they all held in common. In each of the four groups, however, the messages could be passed only in certain specified directions. The four types of restricted communication nets studied in the experiment are diagrammed below.



In the "circle" each person could pass notes to the people at both his right and left but to no one else. The "chain" was like the "circle," except that a complete circuit was not possible. The "fork" was even more restricted: four members formed a "chain" and the fifth member was able to communicate only with one of the inner members of the "chain." The "wheel" was the most restricted of all the communication nets: all messages had to pass through a central member, who was the only one to have direct communication with all the others.

During the experimental session each group completed fifteen problem-solving tasks. This enabled them to develop a plan of operation during the early tasks which enhanced their efficiency on the later ones. The most rapid group to organize a stable plan of operation were the members of the "wheel"; by the fourth or fifth task they had evolved a system whereby the four outer members sent their information to the central member, who determined the answer and sent it out to the others. The "fork" group adopted this same plan of sending all the information to the central member, who figured the solution and sent it out to the other members. Being less restricted, however, the members of the "fork" arrived

at this organization more slowly than those of the "wheel." In the "chain," too, the responsibility of actually solving the problem usually fell upon one member of the group—but, because the organization was somewhat more flexible, different members assumed the role of leader on different tasks.

The members of the "circle" developed no consistent plan of operation but merely sent messages back and forth until each person was able to work out the answer for himself. In spite of the greater organization developed by the more highly restricted groups, the members of the "circle" were able to complete their tasks about as rapidly as the other groups, although they passed a great many more messages.

After the experiment, the subjects were questioned as to how they had enjoyed their jobs. The responses revealed that, on the average, group morale was lowest in the highly organized "wheel," where there was no communication among the members except through a clearly recognized leader. The most contented group was the "circle," which was leaderless but allowed the highest degree of group intercommunication (Leavitt, 1951).

The results of this experiment are in line with other evidence indicating that feelings of individual status and of group membership (or "belonging") are among the most important factors contributing to the morale of the members of a group. When the channels of communication are restricted, the restricted members of a group tend to feel isolated or rejected. There is little to create a feeling of belonging, and group morale deteriorates.

In another experiment designed to study the effects of varying degrees of complexity in problems solved in wheel or circle communication nets, it was found that in solving complex problems the circle was faster than the wheel, with the greatest difference in time showing up on the first trial. With simple problems the wheel was the faster, though not significantly so. Group morale in both wheel and circle groups was higher on simple problems, and those individuals whose positions in the wheel gave them the greatest degree of independence had the highest morale (Shaw, 1954a).

The question of morale, so important to effective group performance, was studied further in another experiment with communication nets.

The communication patterns used in this study were the wheel, the slash, and the circle, shown below.



wheel



slash



circle

The three groups were given rather complex problems to solve. As you can see from the diagrams, certain individuals occupied positions of greater centrality in the group than did others. Also, the experimenter gave some subjects a greater amount of information than others. It was found that increasing or decreasing the amount of initial information given to an individual in a certain position had the effect of increasing or decreasing the centrality of that position. Centrality—or, in this case, centrality plus information—in turn determined the number of items transmitted by an individual, the probability of his being chosen leader of the group, and individual morale, as revealed by a morale questionnaire which the subjects filled out after completing the task. Those in more central positions could communicate more and hence enjoyed their jobs more (Shaw, 1954b).

Not only do central members of a group tend to have higher morale; they also have a stronger desire for the group to succeed and see themselves as more responsible for the outcome of the group effort (Medow and Zander, 1965).

Another study involved circles, wheels, and "all-channel" groups in which each member could communicate with all the others. While the subjects worked at solving complex problems, chimes and buzzers were sounded intermittently—the chimes supposedly indicating good performance and the buzzers poor performance, though both were actually given at random. Under these conditions the all-channel groups improved their performance and the circles did slightly better than before, but the performance of the wheels declined. The experimenter suggests that stress had been added in each case but that whereas this stress was evenly divided in the all-channel and circle groups, it fell almost entirely on the central person in the wheel. He, in turn, was presumably unable to cope with it effectively and still keep up with the flow of messages he had to handle (Lawson, 1964).

Member awareness of group satisfaction tends to increase the effectiveness of the group, as shown in a recent study.

The subjects, 135 college men, working in five-man groups, worked at problem-solving tasks of three levels of difficulty. By inconspicuously manipulating a switch, each member could signal his satisfaction with the group's activities. In the overt feedback condition, when a subject pressed his switch, lights appeared corresponding in color to the color which had been assigned to him. For covert feedback, only red lights appeared on the panel, no matter who had pressed his switch. The light panel was not used in the no-feedback condition. At the close of the experiment, subjects completed rating sheets measuring their overall satisfaction.

As hypothesized, performance was more effective under conditions of overt feedback than under either of the other two conditions, and covert feedback was superior to no feedback. Also, the effects of feedback were greater for the more difficult tasks. Covert feedback correlated more closely with subjects' rating sheets than did overt feedback, indicating that true feelings were more likely to be expressed anonymously. The results suggest that the communication of satisfaction leads to more complete use of contributions of group members and thus improves performance (Shaw and Blum, 1965).

The Effects of Status

Thus far, we have discussed groups in which all members had equal status, except that the accident of a more central position in the particular net or more information from the experimenter might cause one individual to take a leading role. In real life, however, group situations are likely to involve persons of differing status—teacher and students, boss and subordinates, and so on.

An interesting study attempted to discover what effects a feeling of high or low status may have on communication patterns, perception of others, and feelings of satisfaction or dissatisfaction.

In this study, four experimental groups of eight persons each were used. In each case the members were divided into two subgroups of four members each and told that they would work in separate rooms at solving a joint task. One subgroup would be given a diagram showing a pattern of rectangles. On the basis of messages received from this subgroup, the other subgroup was to reproduce the pattern by placing bricks on the

floor. All communication, both between and within subgroups, was to be restricted to written messages. Messages might be written about anything the participants wished, as long as sender and addressee were clearly designated. All messages had to pass through the hands of the experimenter, stationed between the two rooms, supposedly so that he could record the time of their being sent.

Actually, after being taken to their rooms, both subgroups were told that their part of the job was to arrange the bricks, and the messages they received came not from the other subgroup but from a prearranged series of notes made up by the experimenter. Each subject received eight messages about the position of the blocks and six other messages irrelevant to the task—expressing the desire to get better acquainted, indicating criticism of the addressee, wondering about the real purpose of the experiment, and so forth. Each person also received six irrelevant messages which supposedly came from members of his own subgroup. The participants were thereby encouraged to write similar irrelevant messages, but all their messages were kept by the experimenter.

In some of the experimental subgroups the experimenter created an atmosphere of high status by telling them that they had been assigned the really important part of the task—making sure the bricks were properly placed. Other subgroups were made to feel low status by being told that the really important job (supposedly being done by others) was translating the master diagram into words. Half the high and low status groups were also told that, because the experimenter had not yet decided what division of labor would produce greatest efficiency, they might later be moved to the other room—which, in their view, would be either "higher" or "lower," depending on the artificial status they had already been made to feel. Thus a given experimental group felt: (1) high status, with no threat to position; (2) high status, with a possibility of demotion; (3) low status, with no hope for improvement; or (4) low status, with a possibility of promotion. A control group performed the same task with no mention of status.

When asked at the end of the experiment whether they would prefer the "other" job in a (fictitious) second experiment, many more Lows than Highs wanted to make a change. In their messages, the Highs made more, though not significantly more, favorable comments about the job than did the Lows; but the Lows made significantly more unfavorable comments. The Lows also sent many more irrelevant messages, possibly to provide some escape from the task.

Besides criticizing their job more, the Lows sent more negative comments to the Highs than to each other, whereas the Highs sent nearly all their messages of dissatisfaction to members of their own group, apparently not wanting to deprecate their position in the eyes of the Lows. The Lows expressed most confusion about their task and the Highs the least. It appeared that the Highs—especially those fearing demotion—hesitated to let their confusion be known.

The Controls sent more messages of personal criticism than did the other groups, indicating that the mere introduction of a status difference in the other groups had produced restraints on interlevel criticism. The Lows sent other Lows many criticisms of the High subgroup, whereas the Highs sent all their criticisms of the Lows directly to the Lows. There were indications that the High-mobile and the Low-nonmobile groups tended to reject persons at the other level and thus were the groups most destructive of interlevel cohesiveness (Kelley, 1951).

The threat of a change in status has also been found to be related to conformity of opinion within groups, depending, however, upon the members' expectations of compatibility within the group.

This study involved five-member groups of college students. One member of each group was a confederate who introduced standard comments designed to reinforce the experimenter's statements with regard to comparability of membership and possibility of change in status. Group membership was ostensibly determined on the basis of a test of interpersonal compatibility previously taken by the students. High comparability groups were told that their group was made up of people who should find it easy to agree. Low comparability groups, on the other hand, were told that their members had little in common and would probably experience irritating disagreements.

The task of all groups was to discuss a list of twelve student offenses and rank-order them as to seriousness. Ten of the statements had received moderate ratings when presented as part of a longer list in a preliminary study. Two other offenses, one quite minor and the other serious, were also included. After presenting the task and mentioning that the discussion would be tape recorded, the experimenter left the room, telling the group to begin in his absence. After five minutes he returned and administered a short questionnaire designed to measure subjects' reactions to the comparability orientation and their initial interaction. They were

then given thirteen more minutes in which to reach a consensus.

All groups were told that another group was meeting at the same time to discuss specific penalties for these offenses. Because "the optimal size of discussion groups poses a problem" it might be necessary to move some members to the other group at any time. Downward mobility groups were led to believe that the other group had the "unimportant, routine job," whereas their group had the more important and challenging one. In contrast, for upward mobility groups the ranking task was described as simple and routine, while the other group was presented as having "the really difficult and important job."

After the discussion period, the experimenter recorded the rank order decided upon. Subjects then spent fifteen minutes working at an irrelevant task, after which they were asked to make private rankings of the twelve offenses. The correlations between these rankings and the consensus ranking of the group provided a measure of opinion conformity.

A statistically significant interaction was found between interpersonal comparability and direction of status mobility. As shown in the figure, opinion conformity was greatest among members of high comparability groups who had been threatened with possible downward mobility to the lower status group. On the other hand, the lowest degree of opinion conformity was found in the condition of low comparability and downward mobility (Zeff and Iverson, 1966).

Although the high status groups in these experiments had no real power over the low ones, communication in real life often involves high status groups that *do* exert power over those of lower status. The results of these and other studies suggest that status affects not only the kind and quality of communication in a group situation but also the results of group activity.

Hostility is more likely to arise between two groups that perceive themselves as different than between two groups that perceive themselves as similar, especially when the perceived differences include differences in status. This is true even when the perceived differences do not actually exist.

In one study sixteen three-member groups of male college students were organized. Each group was made to feel either high or low status and in half of the groups of each type a member was appointed leader.

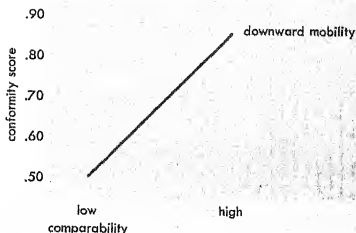
These groups then cooperated with each other in pairs in a task in which they communicated only by notes; in these interactions they knew whether the other group was a high- or low-status group and whether it had an appointed leader but did not know the identity of the members. It was found that with one exception there was a steady increase in unfavorable attitudes toward the other group as the number of differences increased between members' own group and the other groups: those who differed in both status and leadership were more unfavorably perceived than those who differed in only one respect, and those who differed in one respect were more unfavorably perceived than those who were the same in both status and leadership (Mannheim, 1960).

These findings indicate clearly the importance of group members' *perceptions* of their own characteristics and those of interacting groups, for it was these perceptions and not the actual situation that determined their reactions and thus the character of the interaction between groups.

A change in a member's status *within* the group brings about a corresponding change in his performance on a group task.

The subjects were 160 college men. A group reaction time apparatus was used. Whenever a white light flashed on a subject's panel, he was to press a key. He was told that if he pressed the key quickly enough, he would be considered successful; if not, a red failure light

COMPARABILITY, STATUS, AND CONFORMITY



Based on Zeff and Iverson, 1966

would flash. Actually this red light was flashed by the experimenters in accordance with their experimental design, regardless of the speed with which the subject pressed the key. Subjects worked in groups of four and were told that there were fifty groups competing for a prize of ten dollars, to be awarded to the group making the most points. A group would receive points for every trial on which two or more members beat the failure light. Each member was assigned a different number of points to contribute to the group total. This, in effect, gave each of them a different status.

The number of points was assigned on the basis of five practice trials. That is, one member was made to appear successful in all five trials and was assigned a count of 100. The second member was given two failures and a count of 80 points. A third member was made to fail three times and allowed to contribute 40 points, while the fourth member, with four "failures," could contribute only 20. After each block of five trials the group could vote on whether they should change the rank of the members. If they unanimously felt that a change was needed, they decided which member should be assigned the most points in order to give the group the best chance for a high score.

At least two members "succeeded" on each trial. The experimenter varied the pattern of success, however. By the ninth block of trials, for example, the original 100-point man was succeeding only 40 per cent of the time, while the others were doing so 60 per cent of the time. Naturally, the groups reacted by voting to change the point assignments. Thus the original "top man" suffered a reduction in status, while other members gained. Records of the actual performance of the subjects showed that an individual's performance improved when his status was increased but suffered when his status was decreased following his "failure" to do well (Burnstein and Zajonc, 1965).

Group Participation in Decision Making

Many studies have demonstrated that group members are far more likely to accept and adapt happily to changes in procedures if they have become convinced of the value of such changes through group discussion and group decision than if the same final decision has been presented to them by others, even though all of its merits have been clearly explained. During the meat shortage of the Second World War, for example, attempts to persuade women

to buy glandular meats by pointing out their nutritiousness and inexpensiveness generally failed. When women were encouraged to investigate and discuss the advantages and disadvantages of such meats, however, they came to the conclusion that they should buy more of them, and in fact did so (Lewin, 1947).

It has been demonstrated that following the same general method pays off even in industrial settings where one might expect that workers should simply accept the directives worked out by the supervisors and policymakers above them.

This was shown in an experiment in a small pajama factory where the workers highly resented transfers or changes in procedure. Three experimental groups and a control group were matched as closely as possible with respect to efficiency ratings, degree of change to be made, and group cohesiveness. Only minor changes were proposed, such as folding pants in addition to pajama coats, whereas the groups had formerly folded coats with pants that had already been folded. Time allowances were made for each change, since the women were paid on a piecework basis. For the control group, the usual company procedure was followed in instituting the change. That is, the workers, meeting as a group, were told that the change was necessary because of competitive conditions and were given a thorough explanation of the new procedure and new piece rate that was being established.

Experimental Group 1, composed of 13 members, was shown two identical garments, one of which, produced one year earlier, had sold for 100 per cent more than the one produced later. When asked to identify the cheaper pair of pajamas, the group could not do so. This demonstration provided a dramatic method of presenting the problem of cost reduction, and the group agreed that savings could be made without affecting the workers' opportunity to make a high efficiency rating. Management outlined a plan which called for conducting a time study, training a few special operators in more efficient methods, setting a new piece rate by time studies on these trained operators, and eventually training the rest of the workers in the new methods. The group approved this plan and chose the special operators, who then held a meeting of their own. They were exceedingly cooperative and offered a number of helpful suggestions. A similar procedure was used for Groups 2 and 3 except that all members were to be trained immediately, as the "special" ones were in

Group 1. Again numerous suggestions were forthcoming—so many that the stenographer could hardly get them all written down.

Results showed an unusually good relearning curve for Experimental Group 1. The special representative operators and the other members of the group recovered their efficiency ratings at about the same rate. Groups 2 and 3 relearned their work even faster than Group 1 and soon were working at a rate 14 per cent higher than before the change. The control group, on the other hand, showed considerable resistance to the change, expressing hostility toward the supervisor (who was the same person in charge of Group 1), and even deliberately restricting production. They were slower to relearn and remained well below their former production rate during the thirty-two day period of observation. ♡ Almost a fifth of this group quit within forty days of the change; none of the experimental group did so.

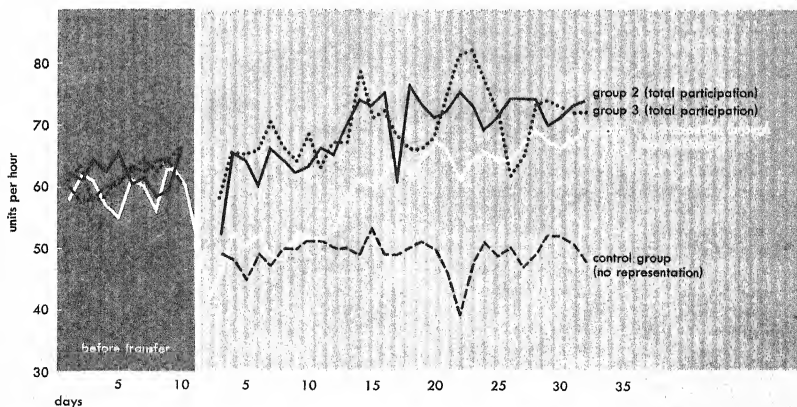
As a further check on the method of group participation, thirteen members of the control group were reassembled two and a half months later and transferred to a new job, using the total participation technique used

for Groups 2 and 3 in the original study. When this method was used, these individuals, who had proved so uncooperative before, learned the new job rapidly, showed no aggression, and showed improved rates of production similar to those of Groups 2 and 3 in the first study (Coch and French, 1948).

Group Pressures on the Individual

Many educators and other leaders have expressed concern over the great tendency toward conformity in our society. They feel that such a premium has been placed on "getting along with the group" that individuality and independence of judgment are threatened.

In a classic experiment investigating the effects of group pressure on individuals, groups of seven to nine male college students were assembled for a "psychological experiment in visual judgment." They were shown

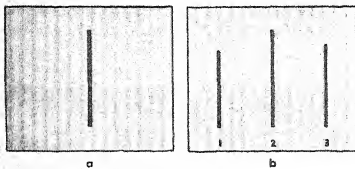


Based on Coch and French, 1948

♦ EFFECT OF PARTICIPATION IN DECISION FOR CHANGE

Originally, performance rates of the four groups were virtually identical. After transfer, level of efficiency was directly proportional to degree of participation in the decision.

cards like the ones illustrated and asked to indicate the line on card b which was the same length as the line on card a.



The lines were different enough that in ordinary circumstances mistakes in judgment would be made less than 1 per cent of the time. All but one of the members of each group, however, were instructed beforehand to give incorrect answers unanimously in twelve of the eighteen trials. Under group pressure the minority subjects, as a whole, accepted the majority's wrong judgments in 36.8 per cent of the trials. But this figure is misleading, for individual differences were marked. Of the 123 minority subjects, about 30 per cent nearly always yielded, even when the difference in the lines was as much as seven inches; on the other hand, a fourth of the subjects remained entirely independent.

Interviews with the subjects at the end of the experiment indicated that many of those who did not yield to the opinion of the majority had strong confidence in their own judgment—after the contradicting responses, they were able to recover quickly from any doubt. Other independent subjects thought they were probably wrong but felt they should be honest about what they saw. Of the subjects who yielded to the majority opinion, some felt immediately that their perception must be wrong, perhaps due to some deficiency in themselves; others said they agreed with the majority "so as not to spoil the experimenter's results." All of the yielding subjects underestimated the frequency of their conformity.

The design of the experiment was changed slightly to investigate the effects of the size of the opposing majority. Pitted against just one person giving an incorrect judgment, the subject exhibited some uneasiness; when the opposition rose to two, the subject yielded, on an average, 13.6 per cent of the time. If three opposed the subject, errors rose to 31.8 per cent. The highest per cent of errors (37 per cent) occurred with seven opponents. Increasing the number beyond this point made no appreciable change in the number of errors on the part of the experimental subject.

When the subject was given an agreeing partner, the effects of the majority were greatly diminished—errors decreased to one fourth of what they had been with no partner, as shown in the graph. If the partner chose the correct line for the first six trials and thereafter voted with the inaccurate majority, however, the experimental subject almost immediately erred as much as if he had never had a partner—his confidence in himself disappeared as soon as he lost his backing. But if the partner simply left the experiment after six trials, the effects lasted: although slightly more errors were made by the subject than while he was being supported by the partner, his confidence in his own judgment was evident throughout the experiment.

If a new subject was introduced who disagreed with both the majority and the experimental subject by choosing the third line on the card, the yielding decreased by about one third. If the new dissenting subject chose the line most different from the "correct" line, while the majority chose the intermediate line, errors of the experimental subject dropped to only 9 per cent—the extreme dissenter had apparently given the subject the courage to stick to his own judgment (Asch, 1955).

A study based on the design of Asch's experiment investigated conformity among college students in two European countries—Norway and France.

The experimental subjects were Norwegian students at the University of Oslo and French students in Paris matched as to age, sex, field of study, and social status. In each session the experimental subject was taken to one of six closed booths where he was given a microphone and earphones. Judgment of the length of acoustic tones was called for instead of judgment of the length of lines as in the Asch experiment. Tape recordings were used to represent five other group members; the experimental subject heard the others only through the earphones, but he had the impression that they were present in the other booths because several coats had been hanging outside the closed booths. The experiments were conducted by a native of the country in which they were performed, and the recorded voices were also of natives. Tests of tone discrimination given before the experiment showed that there was no appreciable difference in acoustical perception between subjects of the two countries.

Four experimental conditions were studied. In the first condition, subjects were simply asked to give their judgments after hearing the recorded judgments of five

stooges. The Norwegian students conformed on 62 per cent of the trials in which the "group" voted against the correct choice; the French conformed on 50 per cent.

The experiment was then repeated with new subjects; this time subjects were told that the results were to be used in designing safety signals for aircraft—a life-and-death matter. There was somewhat more independence, but again the Norwegian subjects conformed somewhat more than the French ones—56 per cent as compared with 48 per cent.

A third series was then run with a new group of subjects. This time judgments were given by secret ballot in order to eliminate the necessity of making a dissenting public response. Both groups showed less conformity, but the Norwegians were again higher—50 per cent as compared with 34 per cent.

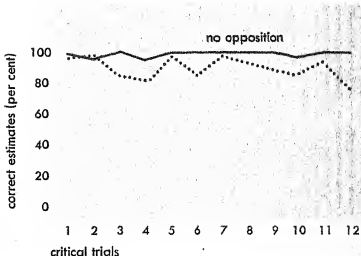
In the fourth condition, dissenters were subjected to open criticism by snickers and such comments as, "Are you trying to be conspicuous?" The French conformity score rose to 59 per cent, whereas the Norwegian soared to 75 per cent. The verbal responses of the subjects were also strikingly different—the Norwegian students took criticism passively, while most of the French students responded with some retaliatory remark. In every situation, the French students showed more independent thought and were less susceptible to group pressures than were the Norwegians (Milgram, 1961).

Other investigators have used Asch's general technique to investigate the relation of sex and age to the tendency to yield to group pressure.

In one such study, using visual discrimination problems with ten- to twelve-year-old children and college students, there were consistent sex differences: female subjects yielded more often to distorted group judgments. The children, as a group, yielded somewhat more often than the college students (Tuddenham, 1961).

The same investigator has also studied the relationship of the compatibility of group members to susceptibility to group influence.

The study involved ninety-five student nurses who first ranked all the members of their class on a sociometric scale from their best friend down to the girl they liked least in the class. On the basis of this information nineteen groups were formed, nine made up of close friends and ten of less preferred companions. Some of the latter included members who actively disliked each other. The subjects were presented with forty-six visual judgment problems on slides, each problem consisting of a nine-part multiple-choice evaluation. Subjects were led to believe that lights appearing on a panel indicated the judgments of other members of the group; however,



Based on Asch, 1955

JUDGMENTS WITH AND WITHOUT SOCIAL PRESSURE

The concern of the dissenting subject is evident as he leans forward to check his judgment. In general, the subjects found this a very disturbing situation. The graph compares the average errors under normal circumstances with those made under social pressure both with and without a supporting partner.

the lights actually showed a pre-arranged pattern of answers. On most trials the lights showed correct judgments, but on fourteen critical trials, when the subject was instructed to answer last in her group, the lights indicated grossly wrong judgments. Yielding on these trials occurred no more often in groups of close friends than in groups less close. Yielding to group pressure appeared to depend largely on individual personality factors rather than on the nature of the group (Harper and Tuddenham, 1964).

This study, of course, involved perceptual decisions only; the composition of the group

might well have more effect on a task involving opinions about social issues. Also, there was no active effort by the other group members to influence the dissenters. Other studies have shown that cohesive groups try to influence their members to conform to the prevailing attitudes and behavior and that the more cohesive they are, the greater their efforts in this direction and the greater their success (Back, 1951). We see this dramatically in the tremendous power that teen-age gangs and cliques have to induce conformity on the part of their members.

EFFECTIVE LEADERSHIP

One area in which the study of group processes has proved particularly helpful has been in pointing out that leadership is not a mystical quality but an effective combination of skills and attitudes. In this section we shall examine the responsibilities involved in leadership, some differences in leadership technique, and the characteristics of effective leaders.

Responsibilities of a Leader

What are the major functions of a leader, and why do most groups need one? As we have seen, even simple perceptions involve the structuring and interpretation of stimuli in the light of previous experience and personal values. It is not surprising, then, that complex social situations may be perceived quite differently by the various members of a group. Members may also have different reasons for joining the group, and be working toward different goals. Nonetheless, the group has some reason for being. Some sort of unification and direction is needed if it is to function smoothly and to achieve its ends.

Structuring the situation. The leader's first function is to structure the situation for the

group members (Stagner, 1956). First of all, he interprets the situation to them, emphasizing certain aspects, clarifying ambiguities, and focusing on certain goals. In doing this he must constantly strive for objectivity, or he may deny pertinent facts and distort the data. If the group members accept the leader's interpretation, the group achieves a unified frame of reference and cooperative behavior is possible.

The leader's task is complicated by certain basic conflicts that are inherent in group activity (Thelen, 1954). For example, there usually is some degree of conflict between individual and group needs and between various aspects of the group's activity. How shall the group's time be spent? What problems must be solved first? What goals are most important? The effective leader must be sensitive to such conflicts, help evaluate them objectively, and guide the group toward a satisfactory compromise program.

The problems of leadership are often complicated by the fact that individual members of the group may be trying simultaneously to solve personal problems and group problems. Some of them may be using the group primarily to gratify their need for social approval or for dominating others. The good leader tries to set up activities in such a way that both individual and group needs can be met. He helps individu-

al members achieve personal goals while they contribute to the group enterprise.

While a problem is being solved by a group, there is always an uncertainty about future action that some members find hard to tolerate. The leader must guide the group's exploration of data and possible courses of action in such a way as to keep this sense of uncertainty to a minimum. If he helps the group formulate its problems into specific questions to be answered, he can satisfy the needs of those who crave definiteness and at the same time help the group to use the facts it has collected.

Controlling group behavior. A second important function of the leader is to prevent or keep to a minimum certain types of individual behavior that are against the best interests of the group. In democratic groups this often means that the leader merely enforces the rules made by the group. But sometimes he may himself make rules governing participation in discussion or other activities. He can enforce the rules of the group by using rewards and punishments, ranging from mild expressions of approval or disapproval to much more drastic disciplinary measures—depending on the strength and orientation of his leadership.

The leader must be alert to the dangers both of an individual's exploiting the group and of the group's exploiting an individual. A problem inherent in group activity is that of how much freedom of expression and action the individual members should be allowed. The quality of the group's leadership largely determines whether the rules are aimed chiefly at establishing an orderly situation or at limiting the individual members.

Speaking for the group. The leader's third major function is acting as spokesman for the group, expressing their hostilities and fears as well as their aspirations and hopes. In order to do this, the leader not only must be sensitive to the emotions of the others but to a large extent must share these feelings himself. As spokesman, he must also be skillful in translating the group's feelings into both words and actions.

Helping the group achieve its potential. To combat group members' tendencies toward pas-

sive dependence on a leader, one school of thought advocates *group-centered leadership*, which incorporates certain insights derived from client-centered psychotherapy (Gordon, 1955). According to this school of thought, the leader's principal goal should be to help the group achieve its potential—much as a parent fosters the development of a child. The leader takes an active role, particularly at the beginning, but the needs and abilities of the group are placed first at all times. The leader tries to create a social climate which encourages individual members to participate in group activities and to feel that such participation is rewarding. He recognizes that each member has a different degree of skill and knowledge to contribute to the solution of each group problem, and he tries to make it possible for the group to use effectively the resources of all its members. The one respect in which all members are equal is that each one's feelings and ideas are data which must be taken into account (Thelen, 1954).

Styles of Leadership

In performing his complex functions, the leader may use any of four basic methods: *force*, *paternalism*, *bargain*, and *mutual means* (Knickerbocker, 1948). All of these are in use today in particular situations, but some seem generally superior to others.

Force. Leadership by force relies in part upon fear for its effectiveness. Leaders who lead by force are usually those whose authority has been vested in them by law (as in the case of the military officer), has been delegated to them by owners (as in the case of a business executive), or derives from personal ownership. Such leaders are sometimes referred to as "headmen" to distinguish them from leaders chosen by the group.

On the American scene, this type of leadership is most closely associated with, or at least most obvious in, the military. It is exemplified by these words of a commanding general to his subordinate officers: "There will be no accidents in this operation. But should there be, I will not ask whether the responsible officer is

unfortunate or incompetent. In either case, his future in this command is behind him!"

The leader who relies on force and fear uses his authority to satisfy the needs of the individuals in his group as he sees fit and to impose upon them his choice of activities. In a group with this type of leadership, the alternative to following the leader is being punished. As the spirit of personal freedom has grown, leadership by force has become rarer in this country. Even leaders whose authority is independent of group assent tend to avoid the use of force whenever possible.

Paternalism. The paternalistic leader tries conscientiously to satisfy the needs of his followers and hopes thereby to gain their loyalty and obedience. Paternalism is still a strong component of modern military leadership. Thus the captain will not eat until the troops have been fed and will not sleep until his men are bedded down.

Paternalistic leadership is also found in many business concerns. Although it is certainly superior to the leadership by force that was at one time typical of the employer (particularly of the master workman with his apprentice), it tends to be unsuccessful. Paternalistic programs are likely to be resented by the typical American worker, who likes to feel that he has earned his pay, that it is his to do with as he pleases, and that he should receive all he earns with no strings attached. Nevertheless, there is considerable evidence of a trend toward making workers dependent on the government, their employer, or their union for such things as disability benefits, hospitalization, and retirement pay.

Bargain. The concept of bargain was introduced in industry to avoid the use of force by either unions or management. The principle of leadership by bargain is that the leader and the members of his group can work out a "trade" to satisfy, at least in part, the desires of each. Thus a minor executive may say to his subordinate, "You give me 100 per cent loyalty and I'll see that you get ahead in the company."

Mutual Means. In this more difficult form of leadership the leader creates a situation in which his own activities and those of the group

members serve as mutual means of gaining satisfaction for everyone concerned. Elected leaders frequently rely on this sort of leadership, especially in informal organizations where there is no law, force, or precedent to support the leader—where he ceases to be a leader the moment the group members cease to follow him.

The four types of leadership discussed here could be placed on a continuum from *authoritarian* to *democratic*. It should also be apparent that the most democratic form of leadership defined above, that of mutual means, requires a person with greater ability to persuade and with greater knowledge of his job than the less democratic forms. Such a leader can never resort to the simple expedient of saying to a member of his group: "Do it or else!"

Group Reactions to Styles of Leadership

What effect does the type of leadership have on the group? Are democratic methods less efficient than authoritarian, as even many lovers of democracy believe? Or does a group work better under a democratic leader who uses persuasion rather than force, education rather than propaganda, conference rather than command? In an effort to answer such questions, a number of studies have been made of the psychological effects of different types of leadership on a group.

The pioneer study in this field found striking differences in productivity, morale, and patterns of aggressiveness (Lewin, Lippitt, and White, 1939; White and Lippitt, 1960). Another psychologist summarized this study as follows:

The investigation "studied the patterns of aggressive behavior in experimentally created 'social climates.' These climates were of three main types—authoritarian, democratic, and laissez-faire. Clubs were formed of boys who, to begin with, were carefully equated, and who were then placed in one of the three experimental groups. In the authoritarian group, for example, all policies were determined by the leader, techniques and activities being indicated by him one at a time so that future steps were always uncertain, and the 'dictator' remained aloof from active group participation except when demonstrating to the others what they were to

do. In the democratic group all policies were determined by group discussion, the members were free to work with whomever they chose, and the division of tasks was determined by the group. In the third situation there was complete freedom for group or individual decision, and the leader supplied the information, but took no other part in group discussions. The factor of personality differences in the boys was controlled by having each group pass through autocracy and then democracy, or vice versa. The factor of the leader's personality was controlled by having each of four leaders play the role of autocrat and the role of democratic leader at least once.

"In one experiment hostility was thirty times as frequent in the autocratic as in the democratic group. Much of the aggression was directed toward two successive scapegoats within the group; none was directed against the autocrat. In a second experiment, the boys in the autocratic groups showed less aggressiveness, but their behavior was of an apathetic type. This lack of aggression is interpreted as due to the repressive influence of the autocrat. Among the boys in these groups there were outbursts of aggression on the days of transition to a freer atmosphere, and a sharp rise of aggression when the autocrat left the room. Nineteen out of twenty boys liked their democratic leader better than their autocratic leader, and seven out of ten also preferred their laissez-faire leader.

"This study is of great interest because it submits to experimentally controlled procedures many of the hypotheses which have been suggested as to the effect of various political structures on individual personality. Students of politics, for example, have observed that fascist dictatorships are frequently characterized by the appearance of a scapegoat upon whom all ills may be blamed. . . . This study has revealed that even in an artificial dictatorship of this type such a scapegoat mechanism may easily be elicited. Although value judgments are not usually regarded as within the province of a social psychologist, the apparent superiority of the democratic over the autocratic form of society may be mentioned as one of the important findings of this study." (Klineberg, 1940, pp. 340-341)

Another study, in which ninety-six air crews (about 1000 men) took part, investigated the effect of type of leadership on group flexibility and confidence.

Preceding the problem-solving task, each crew completed sociometric and group attraction questionnaires

The autocratic leader (top) directs the operation of the group in great detail, demonstrating and criticizing but never participating. The work generally proceeds smoothly but apathetically.

Under a democratic leader (center), the group members feel a real interest in their project and an incentive to do their best. This is because they have discussed and planned the work themselves. The leader works with them as a member of the group but has a special responsibility for guidance at certain times.

The laissez-faire leader (bottom) stands passively by, available for information or help but otherwise aloof from the group. Group interest tends to lag, and individual lines of action frequently emerge.



as a measure of their feelings of "belonging" and ease of communication with each other. They also were asked to estimate as accurately as possible what the performance of their group would be in group problem solving. This was actually a measure of their confidence in their crew. They were then given a test consisting of eight problems with fifteen facts bearing on the solution of each. They were to choose the five most important facts for each problem within sixteen minutes—too short a time for concerted group action on all problems. Thus, although the crews were accustomed to work as a unit, some form of division of the work was required, for which flexibility would be necessary. After the problem-solving session, the subjects completed a scale which measured conformity and one which measured authoritarian attitudes.

The more flexible groups—the ones able to organize most efficiently for solving the problems—proved to be those whose leaders were low in authoritarianism but relatively high in tendency to conform to the opinions of the group. Furthermore, group confidence was higher not only in groups with high attraction scores but also in groups whose leaders were more willing to conform to group opinion (Ziller, 1958).

The relationship between authoritarianism and being chosen as a leader has also been investigated.

The study involved 268 naval cadets who were asked to indicate the three cadets they considered best qualified to act as "student commander" of their section and the three they considered least qualified. The cadets who were nominated as best qualified were significantly less authoritarian (as measured by a special test) than those regarded as least qualified. This finding is all the more interesting because it occurred in a military setting (Hollander, 1954).

What Makes a Good Leader?

"Ask Dave to be chairman. He's a born leader." We have all heard suggestions like this many times. Is Dave really a "born leader," or has he become a leader through training? This question has more than academic interest in our nation, where the problem of obtaining good political candidates, good teachers, good supervisors in industry, and good officers in military organizations is of extreme importance to

the security and efficiency of our whole social system.

In the past, it was thought that some people were born with certain traits that fitted them to assume command, and the study of leadership consisted of analyzing these traits. Personal characteristics are indeed a factor in leadership, but many studies have pointed up the fact that the nature of the situation and the composition of the group are also of great importance. For example, some situations demand that the leadership role be taken by the member especially skilled in problem solving or particularly qualified to direct some other type of activity. In fact, one investigator has found that leaders differ significantly in personality patterns—and that they are not necessarily possessed of the characteristics designated most often by group members as "leadership qualities" (Cattell and Stice, 1954).

The nature of communication in the group also plays a significant part in determining what kind of person will be an effective leader. An individual will usually be regarded as a group leader when he has a central position in the communication network (Goldberg, 1955). In less highly structured groups, persons who initiate the most communication are likely to emerge as leaders (Shaw and Gilchrist, 1956).

Personal characteristics. Although the qualities required of a good leader vary greatly from one situation to another, it has been found that leaders in most situations are distinguished by three important characteristics: their awareness of group attitudes (social perception), their ability in abstract thinking, and their good emotional adjustment. Personal popularity may also play a part.

Awareness of group attitudes. Social perception—awareness of the feelings, opinions, and attitudes of others in the group—has been demonstrated to be a distinguishing characteristic of persons chosen as leaders.

Four organized groups of college students were selected for study: a religious group, a political group, a medical fraternity, and a medical sorority. Each group was thus organized around definite interest patterns and each provided an opportunity for face-to-face relationships in which leaders could emerge.

A special attitude questionnaire was administered to each group. The questionnaire was divided into three parts, with items designed to measure opinions at three different levels of relevance to the group's common interests. Every member of each group was requested to make two judgments in regard to each item in the questionnaire: (1) to state whether he agreed or disagreed with the item and (2) to estimate what per cent of his group would agree with it.

Sociometric data (measures of social acceptance and interaction) were then collected for each group by having the members answer four questions: (1) Who are the three persons who, in your opinion, are most capable of acting as president of your group? (2) Who are the three persons who, in your opinion, most influence the opinions of the group? (3) Who are the three persons who, in your opinion, are most worthy of acting as representatives of this group at a convention? (4) Who are the three persons in this group with whom you would most like to be friends?

The results showed quite clearly that those designated as leaders were much better able than the nonleaders to judge group opinion on issues relevant to the aims of their groups. On the other hand, they did not show superior ability to estimate group opinion on material unrelated to the purpose and interests of the particular group (Chowdhry and Newcomb, 1952).

Another experiment investigated the ability of appointed leaders to estimate the relative popularity of members of their group.

Each member of sixty-three infantry rifle squads was asked to make two rankings of the members of his squad—according to how well he liked them personally and according to how well he thought they were liked by the group as a whole. In the latter ranking he was to include himself. By ranking the men according to the average position given them by their fellow members, the experimenters were able to identify the actual preference hierarchy.

Both the leaders and the more popular individuals, as a whole, were more perceptive of the group preference hierarchy than were nonleaders and less popular members (Greer, Galanter, and Nordie, 1954).

Other investigators have suggested that such results may be attributed to the fact that leaders are more influential than other members in determining group opinion in the first place (Talland, 1954).

Leaders are higher than nonleaders in *empathy*—the ability to perceive the feelings and needs of others.

In one experiment participants in eighteen groups of five members each were asked, after discussion of a problem, to list their preferences for a leader if the group should meet again. At the same time they were given two empathy tests. The individuals most often selected as future leaders received significantly higher empathy scores than did the other members (Bell and Hall, 1954).

In another, more recent, study a group of supervisors in the missile industry were given the Leadership Evaluation and Development Scale (LEADS), a test of sensitivity to human interactions in work situations. Their scores were found to correlate positively with their actual success on the job as measured by salary, with seniority held constant (Tenopyr and Ruch, 1965).

LEADS consists of a series of true-to-life situations. The subject reads these and answers a series of multiple-choice questions based on them (Mowry, 1964). A sample case, not used in the published test, follows:

Jim Mills, the Supervisor in Department "B," had over 35 years of service with the Company. Jim was sore. Two of his men had been idle for nearly two hours because some parts did not arrive from Department "A" as scheduled.

Jim decided to find the reason for the delay. He went to Department "A," where he found Bill Jones, the Foreman, talking to two of his employees about a rush job that was just being started. Without waiting, Jim went over to Bill.

"Say, Bill, where are those parts that you should have had in my department two hours ago?"

"Jim, I'm sorry, but we've been so tied up here with those two special orders for Green and Company that we haven't been able to get the stuff out for you."

"I run my department on schedule, but, of course, my people work. If you kept your people on the ball, you wouldn't be behind schedule."

"Now hold on a minute, Jim, you know this doesn't happen often. You usually get your stuff on time. These special orders broke into our schedule. I've explained that to you already."

"Always an alibi! Well, don't think I am going to take the blame when this order misses the shipping date."

It's your fault, and believe me, the boss will be told where the trouble lies."

With that Jim turned and went to complain to their boss.

Bill and Jim's boss calls them in for a conference. He should:

1. Get Bill to promise he will notify Jim of delays in the future.
2. Have Bill and Jim shake hands and agree to be friendly.
3. Try to discover the real cause of friction between Bill and Jim.
4. Make Jim apologize to Bill for his outburst.
5. Stress the importance of a continuous flow of production.

(The correct answer is given on page 570.)

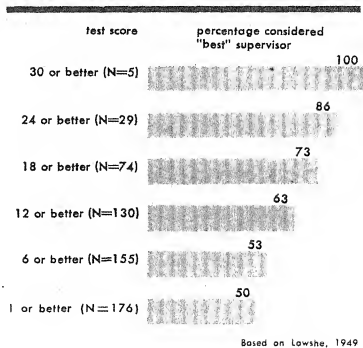
Ability in abstract thinking. Many studies in industrial and military organizations have shown that the leader is usually brighter than his followers—more capable of abstract thinking. One study has reported that of all the various devices employed in selecting officers for the British Army "... intelligence rating is the most valuable single aid ... one could not hope to dispense with it." (Harris, 1949) Studies with officer candidates in the United States Army and with naval cadets have also shown a high correlation between intelligence and leadership ability (Jensen and Rotter, 1947; Hollander, 1954). Other studies have shown that good industrial supervisors are superior in intelligence to poor ones (Stockford, 1947; Lawshe, 1949). The findings of one of these studies are shown in the graph. ■

The importance of the leader's intelligence in assuring effective group performance, however, depends to a large extent on the cohesiveness of the group.

The relationship between the leaders' intelligence, as measured by the Army General Classification Test, and performance of twenty-five army tank crews was studied. Group tests involved field testing different kinds of tanks. The cohesiveness of each group was determined by sociometric data obtained at three points during the experiment. Among the more cohesive groups, those with more intelligent leaders were more proficient. Among the uncohesive groups, however, the

■ AGREEMENT BETWEEN TEST SCORES AND RATINGS

Heads of 88 companies were asked to send 2 men to be tested—one whom they considered representative of their best supervisors, the other representative of their worst supervisors. All the men were given a short pencil-and-paper test of mental alertness, measuring several primary mental abilities. It is clear from the graph that those regarded as excellent supervisors in their companies got the best scores on the test. Of the men who got a score of 18 or better, for example, 73 per cent were from the "best" supervisor group. The higher the score, the higher the percentage of "best" supervisors among those obtaining it. This test, therefore, might well be used for personnel selection of supervisors—candidates receiving high scores would be much more likely to be good supervisors than those receiving low scores.



Based on Lawshe, 1949

leader's intelligence had little relation to group performance. Thus we find that there is interaction: the factor of high leader intelligence has different effects at different levels of group cohesiveness. The investigators attribute this to the fact that the leader can contribute little to the actual task when he is trying to hold the group together and obtain cooperation (Fiedler and Meuwese, 1963).

Good emotional adjustment. Emotional stability is another important factor in leadership.

In a study by the British Army, it was found that good officers were superior to poor ones in the following

personality traits, as appraised in psychiatric interviews: warmth of feeling, spontaneity of expressive behavior, objectivity of social thinking, and cooperativeness of social thinking (Harris, 1949).

A study of Peace Corps candidates undergoing a stressful training period investigated the question of whether leaders experience more anxiety under stress than nonleaders.

The subjects were fifty trainees, similar in age and mostly with some college training, observed during an eighteen-week training session in Puerto Rico. Stress was provided by a series of real-life problem situations as well as by frustrating living conditions and by the knowledge that their eventual selection for duty would depend on satisfactory performance during this period. New small groups were constantly being formed in which the members started out with equal status. The leaders who emerged in these situations had the double task of helping the group attain its goal and keeping the members harmonious and productive.

Near the end of the training period each trainee nominated five people he felt could be relied upon for leadership in difficult situations. Those designated as leaders were individuals who had been shown by a self-inventory given halfway through the training period to be significantly higher in anxiety under stress than nonleaders, with the most highly regarded leaders showing the highest anxiety level. That this was specifically anxiety under stress and not high general anxiety is shown by the fact that all of the trainees had had low scores on a scale measuring chronic anxiety level given before the group had left the United States (Armilla, 1964).

The leader's opinion of himself is another important factor in his ability to lead effectively. Usually only persons with a fairly high degree of self-esteem attempt to lead others.

In one study, interviews with sorority girls who had emerged as leaders in discussion groups revealed that they had a much more wholesome concept of themselves than did nonleaders. They expressed many more favorable comments about themselves and their ability to influence others. They also perceived a larger number of things and people as affecting them pleasantly; they regarded their environment as essentially safe and pleasant rather than threatening. Nonleaders, on the other hand, had poorer self-concepts and expressed many more negative attitudes (Gebel, 1954).

The leader's self-estimate, however, must come close to the group's opinion of him if he is to lead effectively. This is shown in a recent study involving fifty-one groups of ROTC cadets.

Each group evaluated ten problems, providing a total of 510 discussion sessions for study. Each person rated himself and his fellow members, indicating on a five-point scale the extent to which a member's removal from the group would be a loss to the group.

Self-ratings were compared with average esteem ratings in the cases of all individuals who had attempted to lead a group. It was found that those whose self-evaluation was about equal to or slightly below the group's evaluation of them had been significantly more successful as leaders than those whose self-evaluation was higher than that of the group (Bass, 1961).

Leadership and "followership." Although, as we have seen, research has established several consistent differences between leaders and followers, there are certain basic skills and attitudes which all members of a group must have if the group is to function effectively. Thus one study has found a high correlation between effective leadership and effective followership (Hollander and Webb, 1955), and another has found a number of personality characteristics to be common to effective leaders and effective followers.

The characteristics of seventy-two men were studied during a twelve-month period of isolation in Antarctic scientific stations. The men worked in groups of seven-teen to nineteen individuals. Periodically and at the end of the year they were independently rated by military and civilian supervisors on overall performance and on twenty-one personal characteristics. On the basis of these ratings they were classified as being either liked leaders, less-liked leaders, liked followers, or less-liked followers. Both types of leaders differed from the followers by being significantly higher in self-confidence, alertness, job motivation, and aggressiveness. However, on the overall profile of characteristics, liked leaders and liked followers were the most similar groups. These two groups resembled each other most strongly in their high degree of satisfaction with work assignment, emotional control, acceptance of authority, and motivation to be a part of the group and work as a team (Nelson, 1964).

Factors in the situation. Over the years there has been considerable interest in the role of the particular situation in determining the requirements for effective leadership. For example, will different kinds of individuals emerge as leaders in different kinds of situations?

In an experiment to study this question, twenty-five male students in a beginning psychology course were used as volunteer subjects. Each participated in a series of discussion groups made up of five subjects who had never met previously. Over a period of six weeks each man appeared once and only once with every other man. The topic for discussion was what to do about a particular student adjustment problem, a different problem being discussed in each group. At the end of each session the members of the group were asked to nominate a discussion leader for a hypothetical second meeting of the same group. It was found that the same individuals tended to be nominated as leaders regardless of the group or the task (Bell and French, 1950).

Under the conditions of this experiment, leadership proved to be more a matter of individual than of situation factors. It must be remembered, of course, that the situations here were all relatively similar (discussions of student adjustment problems), as were the subjects themselves (male volunteers of about the same age, all beginning psychology students). With a wider range of tasks and more varied memberships in the different groups, we would expect the situation to play a somewhat more important role.

We have already seen that the leadership changed in one of the camp groups (p. 548) as the rivalry between the groups became more bitter and the group felt that a more aggressive stance was needed. Other studies, too, have shown that the traits and attitudes associated with effective leadership in one situation may not be the same as those predictive of effective leadership in a different situation.

In an attempt to discover how leaderless groups select one member to act as leader, forty-nine groups of four or five men each were asked to discuss human relations

problems. Observers tallied the number of interactions each member engaged in. After the group had reached a conclusion, subjects gave each other sociometric rankings, indicating which member contributed the best ideas for solving the problem, which one did the most to guide the discussion and keep it going, and which member stood out mostly clearly as leader.

From subjects' scores on the Strong Vocational Interest Blank and the Minnesota Multiphasic Personality Inventory, forty-two psychological test variables were obtained. The only one which showed a consistent relationship to the leadership ranking was masculinity as measured by the Masculinity-Femininity scale of the Strong Vocational Interest Blank. In general, the men designated as leaders tended to be those who had the highest rate of interaction, indicating that emergent leadership in a group depends more upon the interaction within the particular group than upon particular personality traits of the individuals involved (Harrell, 1964).

Another researcher investigated effective leadership in several types of groups. He found that, among the leaders who were accepted by the members and had close relationships with their key subordinates, a characteristic that dependably predicted effectiveness was seeing their most- and least-preferred co-workers as differing in personality traits. He interpreted this as reflecting a strong task orientation on the part of the leader (Fiedler, 1958).

In subsequent studies with laboratory groups where creative efforts were called for, however, the same researcher discovered that his original finding held true only in cases where there was a relatively unpleasant group atmosphere and a task-oriented leader was apparently needed to help the group achieve the goal. When the group atmosphere was pleasant and relaxed, the reverse was true: the effective leaders were the ones who had similar perceptions of their most- and least-preferred co-workers. In the pleasant groups, whose relaxation already provided a climate favorable to creativity, the style of leadership that had been effective with the earlier types of groups and tasks was ineffective and possibly even a deterrent. A trait that made for effective leadership in one situation was a handicap in the other (Fiedler, 1962).

One would expect that differences in groups, differences in the tasks to be performed, and differences in the surrounding environment and general climate would all influence what traits

and behaviors would be needed in an effective leader. Thus leadership research today increasingly is concerned less with the characteristics of the particular people who for one reason or another are acting as leaders and more with the interaction of the leader, the group, the task, and the larger setting.

Training for Leadership

Although successful leadership depends on both personality and situational factors, leadership ability *can* be taught. Even those who have had practice at leadership and have proved ineffective can be taught to be better leaders.

In one study the subjects were six mediocre leaders on a WPA project for children. Half of the subjects were given retraining and half were not. The two groups were equated on the basis of age, sex, skill, and previous experience.

The training sessions began with discussion of general principles of recreational group work and of the qualities of good leaders. The trainees then made specific formulations of their own objectives and discussed the best techniques for reaching them. Finally, they watched their trainer leading a group of children, saw films of expert leaders, observed and evaluated one another's techniques, and acted the roles of children while the leader used various methods. Emphasis was on principles rather than on the learning of a "bag of tricks."

One important result of training was to improve the morale of the trained leaders. At the start they had not felt much involved in their work and had done only as much as was necessary to keep their jobs. Toward the end of the experiment these same leaders showed absorbed interest in their work, went to considerable effort and expense to help their groups get materials, and willingly committed themselves to long-range plans.

A second result of the training was to improve the morale of the children's groups. These developed a constant membership and showed great initiative in reaching new levels of productivity.

Some of the changes in leadership method brought about by training are shown below. The untrained leaders continued using the old methods (Bavelas, 1942).

Leaders	A	C	E
Before training:			
use of authoritarian methods	77%	77%	51%
After training:			
use of authoritarian methods	4	7	11
use of initiative-stimulating, democratic methods	73	73	89

The best method for training leaders may vary in certain details from situation to situation. Nevertheless, the experiment described here suggests several useful principles of leadership training—and offers dramatic evidence as to the effectiveness of such training.

We have all had the experience in our families and other small groups of having to cope with individuals or subgroups whose goals were at odds with those of the rest of the group, making for friction and distracting or subvert-

ILLEGAL BEHAVIOR of to lower-actor has ing efforts toward the goals of the group, statistics for whole. When this occurs in the society, because they whole, we call it crime or delinquency. In a child's section we shall examine both the predictive of lead to such rebellion against

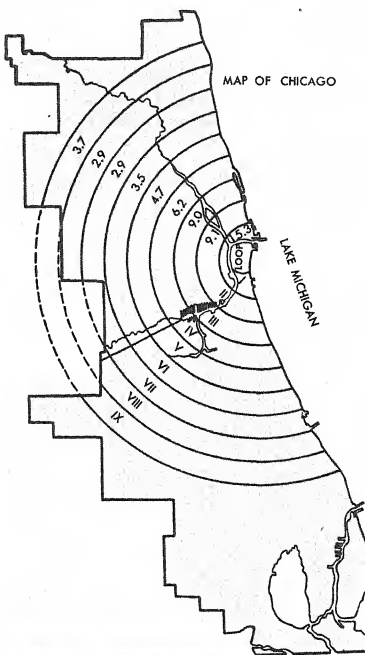
Living in a transitional area. Delinquency is highest in areas that are in a process of transition from residence to business and industry (Shaw, Zorbaugh, McKay, and Cottrell, 1929). These areas are characterized by physical deterioration and poverty. The population is decreasing and neighborhood culture and organization are breaking up. Consequently, the group code of behavior is not well established, and there is less social pressure on the individual to conform to legal standards. The classic study cited above and later ones by the same workers have been summarized as follows:

"In a careful survey of juvenile delinquency in Chicago among boys from eleven to seventeen years of age, it was found that the city could be divided into a number of zones or delinquency areas, starting with the central or Loop district and progressing to the residential suburbs. In all, [nine] such zones were mapped at one-mile intervals from the center. It was found that there was a progressive decrease in the proportion of delinquency from the center to the periphery of the city. The study extended over a considerable period of years during which the population of the central area changed completely without affecting this relationship. There were, for example, successive waves of migration from various European countries, as well as of Mexicans and Negroes, but the delinquency rates remained substantially the same. This has usually been interpreted as meaning that the social and economic setting, rather than the nature of the people concerned, has a definitive influence upon the delinquency rate." (Klineberg, 1940, p. 532)

The relationships between socioeconomic status, transitional areas, and delinquency have suggested several interpretations of illegal behavior. The most common of these is that such accompaniments of low socioeconomic status as family breakdown, low educational level, slum living, and poverty together result in an impoverished environment which often proves detrimental to normal psychological development.

Family breakdown. A thorough study in the state of Connecticut found delinquency to be essentially a symptom of family breakdown. When the family disintegrates, whether because of emotional tensions, death, or divorce, the child may be deprived of affection, feelings of

security, social opportunities, and physical necessities. If a delinquent gang can satisfy some or all of these needs, the child may come to rely



▲ AREAS OF DELINQUENCY IN CHICAGO

This map of Chicago shows how the rate of delinquency varies with the section of the city. Note that central zones I, II, and III, which are transitional areas, have the highest delinquency rates and that the rates grow progressively less toward the residential suburbs. The delinquency rate is the ratio of the number of male delinquents appearing in Chicago's Juvenile Court from 1917-1923 to the total population in 1920 (Shaw et al., 1929).

on it and, in turn, give it his primary loyalty. Interestingly, although lack of family protection was found to be at the root of most juvenile delinquency in this study, there were a few cases in which the children had been overprotected (Robinson, 1947).

There is some evidence that the importance of a broken home in and of itself has been overemphasized (Smith, 1955). It is true that a higher rate of delinquency has been found among boys who have lost their fathers (and among girls who have lost their mothers), as well as among boys whose fathers were absent from home during their early years (Gregory, 1965; Siegman, 1966). On the other hand, some studies have concluded that a number of the effects often ascribed to the absence of the father may actually be due to the presence of intense conflict, rejection, and deviance on the part of the parents—factors which often contribute to the breaking up of the home (McCord, McCord, and Thurber, 1962). Some evidence supporting this hypothesis is provided by a finding that, among mothers of child guidance clinic patients, those who had been divorced or separated were significantly higher in impulsiveness, anger, and nonconformity usually associated with personality disorders than were those who had been continuously married. The children—particularly the daughters—of the divorced or separated mothers were more frequently rated as aggressive (Loeb and Price, 1965).

Micro-factors: environmental. Two of the more specific environmental factors investigated in relation to delinquency are child-rearing practices and the influence of age-mates.

Child-rearing influences. Since child-rearing practices are an important influence on the development and behavior of children, we might well expect to find specific parent-child relationships associated with illegal behavior. The pioneering studies in this area are those of Sheldon and Eleanor Glueck.

Over a ten-year period the investigators studied 500 persistent delinquents and 500 nondelinquents. The two groups were matched for age, IQ, ethnic group, and socioeconomic status. Over 400 variables were studied, including physical factors, psychiatric factors, psycho-

logical factors, and family relationships. In addition, an intensive social history of the family and personal background of each child was obtained. Ultimately, three scales were developed which distinguished between delinquents and nondelinquents with varying degrees of accuracy. These were: (1) a social scale describing parent-child relationships, determined from interviews with the parents; (2) a character structure scale, determined from Rorschach tests administered to the two groups of youngsters; and (3) a temperament scale, determined by psychiatric interviews with both groups of youngsters. The social scale provided the best differentiation between delinquents and nondelinquents (Glueck and Glueck, 1950, 1952, 1956, 1959). The table describes the factors identified in this scale and gives the percentage of cases in which each factor was found to be associated with delinquency.

Social factors	Delinquency rate
Discipline of boy by father	
Overstrict or erratic	71.8%
Lax	59.8
Firm but kindly	9.3
Supervision of boy by mother	
Unsuitable	83.2
Fair	57.5
Close or suitable	9.9
Affection of father for boy	
Indifferent or hostile	75.9
Warm (including overprotective)	33.8
Affection of mother for boy	
Indifferent or hostile	86.2
Warm (including overprotective)	43.1
Cohesiveness of family	
Unintegrated	96.9
Some elements of cohesion	61.3
Cohesive	20.6

Numerous other studies report a relationship between child-rearing practices and delinquency.

In one study the investigators conducted intensive interviews of both mothers and fathers of twenty-six delinquent and twenty-six nondelinquent boys. The two groups were matched for age, IQ, and socioeconomic status. The parents were still married and living together

at the time of the interviews. Some of the findings are as follows: (1) both mothers and fathers of the delinquent group were significantly less affectionate toward their children; (2) both mothers and fathers of the delinquent group encouraged aggression outside the home significantly more often than parents of the nondelinquent group; (3) parents of the two groups did not differ in terms of punishment of aggression toward themselves, but both mothers and fathers of the delinquent group were significantly more punitive of aggression toward other adults. Thus this study finds lack of affection and inconsistency in discipline to be related to delinquency. These findings are entirely congruent with the Glueck findings (Bandura and Walters, 1959).

Similar results were obtained more recently in a study of forty-four delinquents and fifty-three nondelinquent junior high school students. Both the youngsters and the parents of both groups filled out questionnaires designed to measure protection and discipline, two of the most important functions of parenthood. Both the delinquent boys and their parents felt that the boys were neither accepted nor trusted but were strictly controlled by their parents. Also, in the delinquent group greater inconsistency was found between parents' and boys' judgments on the parents' attitude toward their sons (Ando and Niwa, 1963).

Peer-group influences. There is considerable evidence that delinquents seldom carry out their illegal behavior alone. Most delinquents are arrested in company with others. In one study of 5480 delinquents in Chicago, it was found that 81.8 per cent of those apprehended had one or more companions (Shaw *et al.*, 1929). In another study, 67 per cent of 3000 delinquents were found to have "undesirable" companions (Healy and Bronner, 1936). The Gluecks, after comparing 500 delinquents with 500 matched controls, report that "delinquents almost without exception chummed largely with other delinquents while the nondelinquents, despite the fact that they too lived in the slums, had few intimates among delinquents." In fact, 98.4 per cent of the delinquents associated with other delinquents, while only 7.4 per cent of the nondelinquents associated with delinquents (Glueck and Glueck, 1952).

Because these facts are so well known to law enforcement officers, the concept of "guilt by

association" has developed. In Australia, for example, it is illegal for anyone to associate with a known criminal. In the United States it is typically made a requirement for a parolee or a person on probation that he not associate with criminals.

The peer group has generally been viewed as the vehicle through which an adolescent learns the norms, attitudes, and skills of his subculture. There is common agreement, however, that the delinquent, like the nondelinquent, tends to adopt the values and behavior prized by those whose acceptance he values and that many delinquents get their *only* acceptance and approval from delinquent associates.

Influence of portrayed violence. There is some disagreement as to whether or not the depiction of horror and violence in movies, television programs, and comic books contributes to delinquency. Certainly there can be little quarrel with the fact that crime and violence play a large part in many children's television programs, as well as in adult programs which children are often allowed to watch and in movies which they attend. Many persons feel that seeing so much violence depicted on the screen, or in the horror comic books, is bound to lead to increased violence in the behavior of children. However, some psychologists believe that crime stories or movies act as a sort of safety valve by providing young viewers with an opportunity to express hostility vicariously.

A well-controlled recent study appears to support the views of the former group. The subjects were eighty-eight male university students, who, being older than the average potential juvenile delinquent, would be presumed to be less susceptible to film influences. As each subject arrived at the laboratory, he was met by the experimenter and another student, who was actually the experimenter's accomplice. For half the subjects this accomplice was introduced as Kirk Anderson; for the other half he was called Bob Anderson. Subjects were told that the experiment concerned problem-solving ability under stress, and were given an opportunity to withdraw if they were unwilling to receive electric shocks. The subject was given five minutes to write a solution to a problem concerning how an automotive service station could attract more customers. This solution was then "evaluated" by the accomplice, who was to administer from one to ten electric shocks depending

on its quality. Actually, the accomplice administered either seven shocks, to produce the angered condition, or only one shock (nonangered condition). Responses to a questionnaire administered at this point indicated that anger was successfully induced in those subjects in the angered condition.

Next the two men viewed a brief film, ostensibly in order to study the effects of a diversion upon problem-solving effectiveness. For the aggressive movie condition, half the angered and half the nonangered subjects saw a seven-minute film clip of the fight scene in the movie *Champion*, in which the actor, Kirk Douglas, received a beating. The experimenter casually pointed out that Kirk Douglas had the same first name as the accomplice. The other half of the subjects saw a seven-minute film which depicted an exciting but nonviolent competition—a track race between the first two men to run the mile in less than four minutes. After the film, the accomplice wrote his solution to the service station problem, after which the subject was given a chance to administer shocks to the accomplice. The experimenter recorded the number and duration of these shocks (which were not actually suffered by the accomplice). After the subject filled out a final questionnaire indicating how much he liked the accomplice, the experimenter explained the true nature of the experiment.

The angered men who had witnessed the prize fight and who had been told that the accomplice was named Kirk gave a significantly greater number of shocks than the men in any of the other conditions (Berkowitz and Geen, 1966).

These results indicate that in young adults, as in children (see p. 405), observed aggression, while it does not necessarily lead to open aggression, can be a contributing factor when other conditions are conducive to violent or antisocial behavior.

Law enforcement influences. In most studies, illegal behavior is defined in terms of official records of delinquency (court records and probation and police files). But much illegal behavior never gets into the records. A child picked up for stealing may be let off with a warning if he has a father ready to make restitution of stolen property. Most experts agree that the boy from the "right side of the tracks" is likely to be treated more leniently by the police and is more likely to have parents who will stand up for him and be listened to by the law enforcement authorities. Therefore, an un-

known portion of the relationship between delinquency and socioeconomic status may well be "artifactual"; that is, due to a methodological accident—in this case, the fact that the sources are biased. The following investigation reports data which support this viewpoint.

All students in grades nine through twelve in three small cities (10,000 to 30,000 population) were given a check list to fill out anonymously, indicating the frequency with which they had committed various kinds of illegal behavior. There were 3158 respondents.

No relationship was found between illegal behavior as measured and socioeconomic status (defined in terms of father's occupation). Respondents from the upper class admitted to almost as much delinquency as those from the lower class (Nye, Short, and Olson, 1958).

Macro-factors: personality. Not all delinquents come from the wrong side of the tracks, and not all those who live on the wrong side of the tracks become delinquent. Evidently the individual's personality pattern also plays an important role.

It is commonly assumed by the layman that illegal behavior is associated with mental disorders. Using the "classical" categories—neuroses, psychoses, and psychopathic personality—research has not strongly supported this assumption. After a review of the literature, Sutherland and Cressey (1955, p. 121) conclude: "Psychiatric examinations of criminals on admission to state prisons generally show not more than 5 per cent to be psychotic, and in many institutions less than 1 per cent." This figure, however, is probably an underestimate of the rate of psychotics among criminals, since a diagnosis of "insanity" usually leads to hospital commitment rather than to prison. Other studies show a slightly higher relationship between criminal behavior and psychoses (Dunham, 1939; Erickson, 1938), but even in these latter studies, no more than 25 per cent of hundreds of known psychotics had criminal records. These figures are probably inflated because law-abiding psychotics are less likely to be detected and identified as psychotic than the ones who violate the law.

In general, the "classical" types of mental disorders seem to be about as frequent in the

law-abiding sector of our population as in the law-violating sector. The failure of the records to show a relationship between criminality and emotional disorder may, of course, reflect poor diagnostic methods rather than lack of a real relationship between criminality and the classical emotional disorders.

Micro-factors: personality. If there is no consistent correlation between overall emotional disorder and criminal behavior, are there particular traits that tend to be characteristic of criminals? Considerable research has been done on this problem.

Up to 1950 no such characteristics had been identified. In a major review of the literature, Schuessler and Cressey (1950) concluded: "When the results are considered chronologically, there is nothing to indicate that the personality components of criminal behavior are being established by this method. On the contrary, as often as not the evidence favored the view that personality traits are distributed in the criminal population in about the same way as in the general population."

What is the picture nearly two decades later? Recent findings show that a pattern seems to be emerging—tentative, to be sure, but nevertheless consistent from one study to another. Let us examine the more recent evidence.

There seems to be considerable evidence that delinquents are more *impulsive* than nondelinquents; that is, they tend to act before thinking.

In one well-designed study, the Minnesota Multiphasic Personality Inventory was administered to 1958 ninth-grade boys. Two and four years later, a search was made of various public and private agencies for the names of these boys and a delinquency rating was made for each boy. It was then possible to examine MMPI scores in relation to subsequent delinquent behavior (those who were delinquent before administration of the test were omitted). Of the 550 items in the test 33 were found to differentiate between those who later became delinquent and those who did not. Following are some of these items, with the response of the delinquents indicated:

I have never done anything dangerous for the fun of it (F)

I have the wanderlust and am never happy unless I am roaming or traveling about (T)

I would like to be an auto racer (T)

I feel like jumping off when I am on a high place (T)

I would like to hunt lions in Africa (T)

The authors conclude, "If any interpretation of a general sort is possible, . . . it might be that they express a psychological state of youthful exuberance with a love of danger and resentment of restriction." (Hathaway and Monachesi, 1957)

Other investigators have also found evidence of impulsiveness in delinquents. In one early study 46 per cent of a delinquent sample were described as hyperactive as compared to none of a control group made up of their nondelinquent siblings (Healy and Bronner, 1936). Similarly, Glueck and Glueck report "adventurousness" as characteristic of their delinquent sample (Glueck and Glueck, 1952). Other investigators have come to a similar conclusion (Sartin and Jones, 1955).

A more recent study, however, indicates that the relation between aggressive delinquent behavior and inadequate control should not be oversimplified. A total of seventy-six delinquent boys were divided into four groups on the basis of how assaultive their misbehavior had been. The extremely assaultive group, two of whom had actually committed murder, gave evidence of being chronically overcontrolled, with rigid inhibitions against overt aggressive behavior. When the aggressive impulse built up to high enough levels to overcome these rigid controls, the resulting behavior was much more violent than that exhibited by the delinquents with the more typical impulsive personality pattern (Megargee, 1966).

There is growing evidence that another personality characteristic of delinquents is *difficulty in correctly interpreting and evaluating both their own behavior and the behavior of others.*

In one study both impulsiveness and inadequate self-evaluation were demonstrated. The investigators compared nondelinquent boys with habitually delinquent boys who had been in serious trouble more than twice for offenses gratifying immediate needs rather than for offenses resulting from group pressure or neurotic tendencies.

In one of the tests given to these two groups, the subject sat behind a table with a gunlike mechanism and

a pushbutton before him. He faced a screen upon which were shown a "friendly" and an "enemy" plane, and the identifying marks of each were pointed out. He was then shown a series of twenty-five pictures of planes and asked to fire the gun mechanism at enemy planes and to push the button to "clear" friendly planes. Among the pictures were six planes with no identifying marks. Afterwards, the subject was asked what he did in response to these ambiguous planes.

The delinquents were significantly slower and less accurate on the initial trials of designated planes, indicating that discriminations were difficult for them. Although they showed less delay in responding to unmarked planes—indicating a high level of impulsiveness—they did not "fire" at significantly more ambiguous planes than did the controls. However, when asked how they had responded, they stated more often than the controls that they had fired. This supported the investigators' hypothesis that delinquents' evaluation of their own past performance is less accurate than that of nondelinquents (Sarbin and Jones, 1955).

Two other investigators have built a series of predictive test items around the central theory that the delinquent individual is unable to look upon himself as a social object and hence to set up a series of expectancies and critiques. In other words, the delinquent cannot see himself as others see him; he cannot evaluate his behavior in terms of its consequences in the lives of others. He has been called "morally blind," a "social imbecile," and other names descriptive of an immature, self-seeking individual. This scale has been predictive of delinquency among both high-school students and Air Force recruits (Gough, 1954; Gough and Peterson, 1952).

Recent studies indicate that this characteristic blindness or indifference to consequences on the part of the delinquent may extend to consequences which would be unpleasant for himself as well as for others.

In one test of this phenomenon, subjects included twenty-four penitentiary inmates and nineteen students from a university and an adult education center, all males. Twelve of the criminals were classified as psychopathic, that is, as showing an extreme degree of moral blindness or indifference to consequences. Each subject was seated before an apparatus consisting of two keys and a light. When the light came on, he was to press one of the keys. One key brought immediate shock,

while pressing the other produced a shock after a ten-second delay. The subject was required to press each key once so that he would know exactly what would happen and then was given six free-choice trials. The keys were clearly labeled so that he would not forget which produced the delayed shock.

Both the noncriminal group and the nonpsychopathic criminals chose immediate shock significantly more often than the psychopaths (82.3 per cent of the time, as compared to only 55.5 per cent for the psychopathic group). Moreover, the preference for immediate shock increased over the trials for the nonpsychopathic subjects but not for the psychopathic ones (Hare, 1966).

These results indicate that the nonpsychopathic subjects, feeling apprehensive and fearful during the period of delay, preferred to be shocked immediately and "get it over with." The psychopaths, on the other hand, were disturbed very little by the anticipation of the painful future consequences, in this case the shock. In fact, they reported, in brief questioning after the trials, that the waiting period bothered them very little. It would appear that psychopaths do not acquire conditioned fear responses as readily as do normal individuals. The same investigator has demonstrated that psychopathic subjects show less increase in palmar skin conductance (a measure of emotion) while anticipating shock than do normal subjects (Hare, 1965).

A third personality trait which recent research indicates is differentially associated with delinquents and nondelinquents is a *negative self concept*. Delinquents tend to think less well of themselves than nondelinquents, although sometimes, at least, their negative self-evaluations are not in accord with their peers' evaluations of them (Reckless, Dinitz, and Murray, 1956; Reed and Cuadra, 1957; Youth Studies Center, 1961).

In summary, then, impulsiveness, inability to interpret and evaluate self and others correctly, and a negative self-concept seem to be emerging as personality traits more characteristic of delinquents than of the general population.

The influence of a record. Once a juvenile's name is on an official record as having committed a crime, the chances that his name will appear for a second crime are high. Sutherland

and Cressey (1955, p. 411) report the following facts:

"Healy and Bronner report that of 800 boys studied in Boston 24.6 per cent appeared subsequently in adult courts, and that of 420 boys studied in Chicago 61 per cent were failures subsequently, of whom 16 per cent became professional criminals and 5 per cent became murderers. Sheldon and Eleanor T. Glueck found that of 1000 juvenile delinquents in the Boston Juvenile Court and the Judge Baker Foundation 88.2 per cent had additional delinquencies during the subsequent five years and 70 per cent had an average of 3.6 arrests each."

A more recent study followed the military careers of 470 juvenile delinquents. A random sample of 828 boys from the same area and within the same age group constituted the control group. Of the former juvenile delinquents, 45 per cent were rejected or deferred, as compared to 30 per cent of the control group. Reasons for rejection or deferral are even more illuminating: Of the delinquent group, 26.8 per cent received "moral rejections," while of the control group only 2.1 per cent were rejected on moral grounds. The in-service records of those accepted for active service further support the prognosis of poor social adjustment for the delinquent group. The table below shows the percentages of the two groups that achieved varying degrees of military success. "Noncommissioned or Petty Officer or Officer" indicates the highest degree of achievement and "Unsatisfactory" refers to cases where an honorable discharge was not given or where a disciplinary component entered in (Roff, 1961).

	Delinquents	Controls
Noncommissioned or Petty Officer or Officer	22%	58%
Rct, Pvt, Pfc or equivalent	14	25
Minor disciplinary problems	14	4
Unsatisfactory	50	13

These data leave little doubt that a record of juvenile delinquency gives a poor outlook for future social adjustment.

Recent Improvements in Treatment

Several encouraging new methods are being tried in the treatment of both adult and juve-

nile offenders. Recent years have brought great strides in the use of psychiatry and psychology in rehabilitation, as well as greater emphasis upon education, recreation, radio and television privileges, and counseling services (Scott, 1961). The indeterminate sentence, which allows adequate time for rehabilitation and at the same time encourages good behavior, is being more widely used. The federal government and some of the states provide special institutions for the youthful offender who is too old for juvenile court but too young to be placed with hardened adults.

A camp program, although not a new idea, has recently been used with great success.

In Michigan, where youthful offenders had been excluded from the existing forestry camps because it was felt that the younger men were more difficult to handle, one camp was made a treatment center for the youthful group.

Group counseling was a keystone of the program, which was "built around the concept of the conscious cooperation of all elements within it for the welfare and development" of the inmates. All campers were required to attend twelve weekly sessions of one hour each, after which they were free to attend or not as they chose. Nothing said in the group was to be held against a member, and leaders were encouraged to be completely sincere. Silent members were not urged to speak but often would surprise the leader by pouring out confidences on the way back to the mess hall after the formal session was over.

In addition to group counseling, the camp program strove to attain the cooperation of guards and to involve the inmates in their own treatment. An important aspect of this was convincing them that all shared the same goal—getting a man out and keeping him out. Fair treatment was insisted upon, as in the case of Willie, who was sent from the camp "back to the walls" on an unsubstantiated charge of being a sex offender. The camp officials showed the charge to be false and got Willie back.

On every Sunday and holiday, families of the men were allowed to bring dress clothes for them and take them anywhere within a radius of fifty miles for a day of fun. All returned on schedule and none ever got into trouble during these furloughs.

The camp program has now been extended to include a Probation-Recovery Camp where those on probation may live if they do not have a desirable home to go

● The Chicago Area Project neighborhood committees sponsor a wide variety of programs including clubs and special interest groups for all ages, contests of many kinds, and even summer camps. At left, a craft group is meeting under volunteer leadership; at right, a group of fathers pitch in to clear an area for a new playground. Such self-help fosters community pride and a sense of belonging.



back to. The community has proved to be very helpful also, contributing funds, tools, and even welding instruction to probationers (Scott, 1961).

Not all prisoners can be placed in minimum-security institutions such as camps. However, improvements are also being made, notably in New York and California, by providing maximum-security centers for the most difficult cases so that those who do not require so much restriction may be allowed greater freedom.

Approaches to Crime Prevention

Criminologists have come more and more to believe that an adult who is a habitual criminal is almost hopeless of rehabilitation. In fact, 70 per cent of the fingerprints received for identification by the Federal Bureau of Investigation prove to belong to persons with previous records of arrest (Hoover, 1957). Students of delinquency and crime are agreed that prevention must start early if it is to be effective. The two most important avenues to crime prevention are community planning and judicial action.

Community planning. Many social institutions can help check delinquency in its early

stages. Such organizations as the Girl Scouts, the Boy Scouts, the YMCA, and various church organizations can direct the gang spirit into useful activities. Slum clearance projects typically provide for playgrounds with adequate equipment and competent supervision. Children who find interesting play in the open are not likely to resort to hideaways in vacant tenement buildings or abandoned stores or factories, as many slum-dwelling children are forced to do.

Professional social workers are also doing a great deal to combat delinquency. Trained to recognize the first symptoms of trouble, they often are able to correct the sources of difficulty before a child becomes seriously delinquent.

An outstanding example of the way social-psychological studies are translated into effective action is the Chicago Area Project. * This Project was organized in 1934 by social scientists at the Illinois State Department of Public Welfare and since 1957 has been staffed by the Illinois Youth Commission, Division of Community Services. The success of this Project has led to the development of others: at the present time there are fifty-five such projects in Chicago and its suburbs.

The project operates on the assumption that the local neighborhood can be organized to deal effectively with its own problems. The founders of the Project did not simply send in

social workers and group leaders foreign to the community; instead, they stimulated the local residents to become aware of the problem of delinquency and to take collective action. They guided the local leaders and local organizations in establishing such activities as camping, baseball, football, basketball, boxing, movies, ping-pong, pool and billiards, music, dramatics, handicrafts, printing, newspaper work, and club discussions.

The activities of the Chicago Area Project have been concentrated in those areas where delinquency rates have been very high, and the results have been gratifying. In at least one area juvenile delinquency rates have shown a marked decline. Equally important is the example set by the Project in attacking delinquency as a community problem.

Judicial action. In all too many cases the treatment of juvenile delinquency is delayed until judicial action is necessary. But even then the hope of rehabilitation is not lost. The modern juvenile court authority tries to become an expert in human relations. He studies the offender as well as the offense and then tries to impose whatever treatment will, in his opinion, prevent a recurrence of delinquency.

Improvements made so far include the practices of probation and parole, the differentiation between juvenile delinquents and adult criminals, and the emphasis on rehabilitation rather than punishment. Outmoded laws and inadequate facilities, however, still interfere with the most effective handling of many cases that are brought to court. Many improvements are needed in police practice, judicial practice, and corrective institutional care. Delinquents should not be treated like hardened criminals, nor should criminals of any age be arbitrarily classified. Furthermore, some students of the problem have suggested that the judicial and penal functions should be separated (Klein, 1945). That is, the power of the courts should be limited to the determination of the individual's guilt or innocence. His custody, education, rehabilitation, and eventual release should then be under the guidance of psychologists and social welfare workers. Unfortunately, in many cities there is a serious shortage of such trained personnel.

CHAPTER SUMMARY

The analysis of social influences on the individual is one of modern psychology's most important tasks, to which experimental psychology, sociology, and anthropology all contribute. The effect of competition is one factor which has been extensively studied.

Psychologists and anthropologists believe that *competitiveness* is learned rather than inborn. Studies of animals as well as human beings support this conclusion. The effect of competition on performance depends on the kind of competition and on the social situation. Often a greater quantity of work of poorer quality is produced in competitive situations. Competition between groups produces bias toward one's own group and often leads to intergroup hostility, which may be overcome by cooperation in working toward superordinate goals.

Various means have been suggested for utilizing the incentive value of competitive conditions while lessening the undesirable effects of competition. One plan involves rewarding improvement rather than rank; another recommends setting up subgroups of individuals of comparable ability. However, the fact remains that our success in many instances depends on our ability to adjust to competitive situations.

Through *social facilitation* and *social interaction* groups can achieve certain goals and solve certain problems more successfully than solitary individuals can, although individual work is usually better for creative thinking. The *risky shift* phenomenon may lead groups to take risks greater than those individual members would take on their own. Among the factors influencing small group functioning is the composition of the group, a high degree of *homogeneity* being helpful for some tasks and a hindrance for others. *Communication patterns* influence both overall efficiency and individual morale. *Status* and *mobility* are also important factors in determining group efficiency, morale, intergroup harmony, conformity of opinion, and expectation of compatibility within the group. In any group relationship it is the group's perception of its own character-

istics and those of the other groups which determine member reactions and thus the character of the interaction between groups. Changes in group procedure are more likely to be accepted willingly and without disruption of productivity if members of the group participate in the decision to change. Group pressures may bring about a high degree of conformity among members, although such conformity is influenced by cultural factors.

An effective leader performs several basic functions. He must structure the situation the group faces, providing a unified frame of reference; he must strive to see that both individual and group needs are being satisfactorily met; he must control the behavior of the group; and he must be able to speak for the group. In group-centered leadership the leader's chief goal is to help the group achieve its potential. In performing his functions, the leader may use any of four basic methods: *force*, *paternalism*, *bargain*, or *mutual means*—representing the range from authoritarian to democratic. Democratic methods usually achieve better results than authoritarian methods, producing greater group flexibility.

Leaders must be *selected*, and they must be *trained*, although position in the group helps to determine who shall lead. In most situations a good leader has three major characteristics: *awareness of group attitudes*, *ability in abstract thinking*, and *good emotional adjustment*. A high degree of *self-esteem* is usually characteristic of leaders, although their self-estimate must come close to the group's opinion of them if they are to lead effectively. Good leaders and good followers have much in common. In general, leaders chosen by the group and those assigned by authority are simi-

lar, but sometimes the situation largely determines who shall be the most effective leader. Training of leaders can improve their morale and their skills.

The first step in unraveling the causes of illegal behavior is to discover the factors commonly associated with it. *Environmental macro-factors* often associated with delinquency are low or dropping socioeconomic status, living in a transitional area, and family breakdown. Child-rearing influences and peer-group influences are important *environmental micro-factors*. There is also evidence that viewing violent films will increase aggressiveness. Law enforcement influences may distort the picture of delinquency somewhat, in that the child of well-to-do parents is less likely to be actually booked or punished.

Among the *personality factors*, actual mental disorders (*macro-factors*) have not been found to be significantly more frequent among law violators than among the rest of the population. However, certain personality traits (*micro-factors*) tend to appear in delinquents to a greater extent than in nondelinquents. Among these are impulsiveness, inadequate self-evaluation and evaluation of the reactions of others, and a negative self-concept. Once a young person has an official record of having committed a crime, the chances that his name will appear for a second crime are rather high.

In recent years several encouraging new methods of treatment, such as *camp programs* and *group counseling*, are being tried for both young and adult offenders. The major avenues to crime prevention are *community action*—involving social organizations, slum-clearance projects, professional social workers, and self-help neighborhood drives—and *judicial action*.

Chapter 16

Outline

PUBLIC OPINION SURVEYS

CONCEIVING THE PROBLEM

DESIGNING THE INSTRUMENT

SAMPLING THE POPULATION

CONDUCTING THE INTERVIEWS

INTERPRETING THE RESULTS

ACCURACY OF PUBLIC OPINION POLLS

THE USE OF PANELS

PSYCHOLOGICAL FACTORS IN ADVERTISING

OBJECTIVES OF EFFECTIVE ADVERTISING

TECHNIQUES OF ADVERTISING RESEARCH

"INSTITUTIONAL" ADVERTISING

TECHNIQUES OF PROPAGANDA

COMMON PERSUASIVE DEVICES

FACTORS IN EFFECTIVE PERSUASION

LONG-TERM EFFECTS OF PROPAGANDA

RESISTANCE TO PROPAGANDA

BRAINWASHING

Chapter 16 Communication and Persuasion

Communication, as we saw in Chapter 10, is a two-way process. Unless the *source* of information has some knowledge of how the information is received at its *destination*, efforts to communicate cannot be very successful. In face-to-face contacts, feedback is relatively simple and direct: we can judge the effect of what we say by our listener's facial expressions, his verbal responses, and his actions. In school, a teacher can measure the effectiveness of his efforts to communicate knowledge and ideas and attitudes by evaluating the new responses—changes in behavior—of his students. In most mass communications, however, the problem of feedback is much more complicated. How can a sponsor gauge the reaction of potential customers to his television commercials when he is addressing an audience of millions? How can a candidate know, during an election campaign, whether his efforts to persuade the public are being successful? How can an elected or appointed official know how his policies or practices are being received by the public?

As educators, advertisers, and politicians have come to rely increasingly on mass communication media, they have come to realize more and more how important it is to measure the reactions of large groups of people and to identify the most effective ways of reaching and appealing to their audience. Whether you are trying to sell a product or an idea, it is important to know what psychology has to say about measuring and changing people's attitudes.

tion needed for far-reaching decisions. Not only is such research helpful in delineating current and historic trends; it can also be of use in the development and evaluation of new policies (Lasswell, 1957).

In recent years, the demands for accurate measurement of public opinion have been so great that psychologists, statisticians, and other specialists have done considerable research on how best to plan and conduct opinion surveys. Opinion polls have been used not only to predict election results but to measure public opinion and knowledge on all manner of topics. In this section we shall examine some of the problems involved in getting an accurate measure of what "the public" or some particular segment of it thinks, knows, feels, and does.

There are five steps or phases in planning and conducting a survey, and each can be a source of error which the competent social scientist is aware of and strives to avoid. These steps are: conceiving the problem, designing the instrument, sampling the population, conducting the interviews, and analyzing the results (Dunnette and Kirchner, 1965). You will probably not conduct a poll in the near future, but knowing the correct procedures will help you to read and evaluate published opinion polls.

Conceiving the Problem

The purpose of the study must be carefully thought out and precisely defined. How is the information to be used? From whom is the information to be obtained? What kinds of information will be obtained—future plans, past behavior, or present feelings? Do you want to find out *why* people respond as they do, or will it be sufficient just to count the various kinds of responses made by the various groups of people contacted?

PUBLIC OPINION SURVEYS

Opinion research techniques have proved increasingly valuable in providing the informa-

Designing the Instrument

There are numerous ways in which information can be obtained from the public: mailed questionnaires, telephone interviews, "depth" or "projective" interviews. The particular advantages and disadvantages of each of these methods will become apparent as we continue this discussion. These must be carefully weighed to determine which procedure is likely to be most effective in obtaining the needed information.

A big problem in opinion polling, whatever technique is used, is that of framing and asking the questions in such a way that the answers will be truthful and to the point. The technique of questioning is a subtle combination of art and science, but certain basic rules have been tried and proven. An understanding of the principles underlying the construction of such questions will be of help to every magazine and newspaper reader in interpreting the results of public opinion polls. Mistakes in the phrasing of questions can lead to gross errors of measurement. An analysis of the known principles about phrasing questions on opinion questionnaires shows that there are four major pitfalls to be avoided (Jenkins, 1941). These are: *biasing the answer, failing to determine the direction of response, exceeding the ability of the respondent to answer, and exceeding the willingness of the respondent to answer.*

Biasing the answer. Questions may be so worded as to suggest a particular answer which may or may not be the respondent's real opinion. Leading questions, such as, "You are a Republican, aren't you?" are obviously defective. Answers also may be predetermined through the use of emotionally worded questions, such as one which was reported in an anti-organized-labor newspaper: "Do you approve the use of force, intimidation, and violence in coercing employees to join a labor union?" Ninety-nine per cent of the respondents answered "No." Using a similar sample of the population in another survey conducted just a few weeks later, this same question was asked along with the following: "Do you approve of the use of force, intimidation, and violence in coercing employees not to join a labor union?" Again 99 per cent said

"No" (Ruch, 1938). The fact that 99 per cent of the respondents said "No" to each question probably meant that they did not approve force, intimidation, and violence but told nothing about whether they approved or disapproved of labor unions.

Failing to determine the direction of response. Ambiguous, vague, or indefinite questions may elicit misleading answers or answers that are hard to analyze. For example, almost everyone would give an affirmative answer to the question, "Do you think that the most deserving people should have a cut in taxes?" However, the definition of "deserving" would vary greatly from one person to another, so that the answers to this question would not cast much light on public opinion about desirable tax cuts.

The question, "Do you own a light coat" could refer to color or to weight and hence is not interpretable. "Double-barreled" questions such as: "How do you rate the social life and athletics at X University?" cannot be answered meaningfully; hence the answers given cannot be interpreted. Suppose that you as a student at X University rated athletics high and social life average? How would you answer the question?

Practitioners of the art of asking questions have learned that *logical* equivalents are not *psychological* equivalents in all cases (Rugg, 1941). The following two questions would seem to ask for the same information:

"Do you think the United States should allow public speeches against democracy?"

Yes - No - No opinion

"Do you think the United States should forbid public speeches against democracy?"

Yes - No - No opinion

A "Yes" to the first question is logically the same as a "No" to the second. That people are not logical is seen in the results obtained from equivalent samples of respondents:

First Question		Second Question	
Yes (should allow)	21%	No (should not forbid)	39%
No (should not allow)	62	Yes (should forbid)	46
No opinion	17	No opinion	15

A better phrasing of this question would be: "Do you think the United States should allow or forbid public speeches against democracy?"

Exceeding the ability of the respondent to answer. Sometimes questions are too difficult and technical for the respondent to answer. For example, a reasonable answer to the question, "How do you think a war with Red China can be avoided?" would require more knowledge than most people possess. Even questions that tap the everyday experiences of all classes of people must be worded so simply that the least educated person will understand them. Technical terms should be avoided, if possible, or explained in simple words. For example, "Do you approve or disapprove of the union-shop contract?" is a poor question, for many people will not know what it is and will confuse it with "closed-shop contract." This question can be made acceptable by adding: "which provides that the employer may hire without regard to union membership of the applicant but provides also that all new employees must join the union at the end of a specified period of time."

Exceeding the willingness of the respondent to answer. Most people will not give truthful answers to a question if honesty will embarrass or incriminate them. The respondent may escape embarrassment by lying; or he may simply refuse to answer. In the Gallup and *Fortune* polls of the 1940 presidential election, the Democratic vote in the South was appreciably overestimated, as was the Republican vote in the North. To some extent, these errors probably reflect the influence of social pressure and an unwillingness of many people to express a minority opinion.

In an attempt to minimize such errors, in 1956 and 1958 the Gallup poll made systematic tests of a secret ballot interview technique, comparing the results obtained by this method with those obtained from nonsecret interviews (Perry, 1960). The secret ballot interview was conducted in the same manner as the non-secret except for the question dealing with actual voting preference. For this the respondent was given a card showing the parties and candidates and was asked to check his choice privately, fold the card, and drop it into a ballot

box which the interviewer carried with him. A comparison of the results showed 60 per cent fewer "undecided" voters in the secret survey in 1956 and 30 per cent fewer in 1958.

In some types of surveys it is desirable to obtain the names and addresses of those interviewed. In many cases, however, respondents are more willing to answer when they are not asked to reveal their identity. For example, a recent study of college students' attitudes toward an English course revealed a small but statistically significant difference between the attitudes expressed by those who were asked to sign their questionnaires and those who were not (Rosen, 1960).

In most cases anonymity probably makes little practical difference in responses, but in situations where the respondent feels threatened, he may give fuller and more candid answers if he is assured that he will not be identified or that the identification will be used for research purposes only.

Sampling the Population

The problem of obtaining a representative sample of the population is one of the most difficult in the whole field of measuring popular reactions. First, the exact public to be sampled must be defined. This might be, for example, all the registered voters in the state of New York or all the farmers in the United States and Canada. The sample to be studied must be drawn in such a way that each individual in the population has an equal chance of being selected, and that the drawing of one does not influence the chances of any other being drawn. With this procedure, each age, sex, income, religious, and ethnic group in the population will generally be proportionately represented in the sample.¹

That the accuracy of public opinion surveys depends first of all on getting a truly representative sample was demonstrated fairly early in the history of wide-scale polling, during the 1936 presidential campaign between Roosevelt and Landon. The American Institute of Public

1. The methods used in obtaining a representative sample are discussed in the Reference Manual (p. 627).

Opinion, known as the Gallup poll, and the magazine *Fortune* were successful in predicting the outcome of the election whereas the *Literary Digest* was in error. The explanation lay in the different sampling techniques used. The first error of the *Literary Digest* was to draw its sample from telephone and automobile owners, who are a relatively prosperous group in comparison with the voting population as a whole. Secondly, the *Literary Digest* conducted its survey by mailed questionnaires, only a small proportion of which were returned. Various studies have since shown that people who do answer and return mailed questionnaires are not typical of the total population (Calahan and Meier, 1939; Shuttleworth, 1940), so that the sample actually analyzed in the *Literary Digest* poll was probably even less representative than that originally selected. The Gallup and *Fortune* polls, however, employed trained interviewers who talked personally with men and women of all social and economic classes.

The mere accumulation of large numbers of respondents will not compensate for bias in the sample. A straw vote of 1,000,000 unrepresentative people will come no closer to representing the vote of the nation as a whole than a straw vote based on 100 equally unrepresentative people. Interviews conducted by telephone will not tell you how people who do not have telephones would respond.

Conducting the Interviews

Even when questions are carefully worded and the format of the ballot carefully designed, a poor interviewer can bias the results. Experience shows that the best interviewers are women, at least twenty-one years of age, who like people, who are unbiased, who are good listeners, who have some college education, and who are fairly familiar with the section they are working in (Dunnette and Kirchner, 1965).

The interview is a rather subjective measuring device at best. When the interviewer has latitude in interpreting the respondents' answers, his own biases will affect the results.

An analysis was made of the interview records of twelve social workers who had interviewed a total of

2000 homeless men applying for free lodging. Although the interview was standardized, the interviewers unconsciously influenced the applicant to give desired answers. One of the interviewers, an ardent prohibitionist, found that the downfall of 62 per cent of the applicants was due to the excessive use of alcoholic drink, while but 7 per cent of the cases of social failure were to be attributed to industrial conditions. Another interviewer, a socialist, found that a mere 22 per cent of the unfortunate men owed their plight to the demon rum, whereas 39 per cent had been reduced to destitution by unfortunate industrial and economic conditions. It is even more interesting to note that the prohibitionist reported that 34 per cent of the applicants themselves mentioned liquor as the cause, while 42.5 per cent attributed their condition to industrial conditions; whereas the socialist reported that 11 per cent blamed alcohol, and that 60 per cent named industrial conditions as the reason (Rice, 1929).

Since the groups of men observed by the two workers were comparable, it is obvious that one or both of the interviewers were not only giving distorted interpretations of the items as noted on the interview blanks, but were actually suggesting the desired answers to the men interviewed. This does not imply that the interviewers were deliberately and dishonestly attempting to build up propaganda for prohibition or against capitalism. It merely illustrates the fundamental fact that our prejudices influence our interpretation of the things other people say and do.

Most public opinion polling and market research organizations use carefully worded questions and require the interviewer to read them *verbatim*. Where "open end questions" such as, "Tell me the one thing you like least about your job," are used, the interviewer records the answer *verbatim*, and the analysis of the answers is made in the home office by carefully trained personnel.

Interpreting the Results

Even when all of the steps in fact finding are carried out properly, there is always a chance for misinterpretation of the findings.

An interesting example of misinterpretation of public opinion poll results occurred in the

1956 presidential campaign (Palmer, 1956). In a front page story published just before the Republican Convention in San Francisco a political writer concluded:

"Nixon as President Eisenhower's running mate this year is preferred by 62.7% of all Republicans, Democrats and independents who said they plan to vote for President Eisenhower.

"Those preferring Gov. Herter represent a total of 24.4%."

The writer of the article went on to point out that 50.1 per cent of the registered voters who were willing to indicate an opinion expressed a preference for President Eisenhower and 32.7 per cent for Stevenson. But the article did not state how many of the voters who preferred presidential candidates *other* than Eisenhower were in favor of Nixon, so that actually there was no basis for computing Nixon's real popularity. If the reader stopped to analyze the figures given in the article—multiplying 50.1 per cent (the proportion of the total voting sample that favored Eisenhower) by 62.7 per cent (of those favoring Eisenhower who also favored Nixon)—he would find that 31.4 per cent was the minimum popularity figure for Nixon.

Part of the difficulty here was in the original design of the questionnaire. A better way to determine the relative popularity of Nixon vs. Herter would have been to ask *all* registered voters to tell which combination had their favor. Such a question might have been: "Which of the following combinations would you like to see nominated at the coming Republican convention: Eisenhower and Nixon or Eisenhower and Herter?"

Accuracy of Public Opinion Polls

By 1948, the American public had come to take public opinion polls for granted. The universal success of the nation's leading pollsters in predicting the outcomes of the presidential elections of 1936, 1940, and 1944 had left most people with little doubt of their dependability. It was with considerable surprise, therefore, that people awoke on the morning following

the 1948 election to discover that the polls had been wrong. The failure of the 1948 election surveys to predict Truman's victory over Dewey naturally raised the questions, "What went wrong? Just how accurate are the public opinion polls?"

Before considering why the 1948 presidential polls were wrong, it is well to consider how far they were wrong. In the table below, the actual election returns are compared with the forecasts that had been made by the nation's three leading polling agencies.

	Percentage of total presidential vote:			
	Truman	Dewey	Thurmond	Wallace
Actual vote	49.5%	45.1%	2.4%	2.4%
Predictions:				
Gallup poll	44.5	49.5	2.0	4.0
Roper poll	37.5	52.8	5.3	4.4
Crossley poll	45.0	50.1	1.6	3.3

It is obvious that all three major polls failed to predict the largest percentage of voters for the winning candidate. But although the results of the Roper poll were considerably divergent from the final returns, both the Gallup and Crossley polls predicted the Truman vote within 5 percentage points. In fact, in terms of percentage point predictions, both of these polls actually made smaller errors in 1948 than they had in the 1936 election, when the Gallup poll successfully predicted the outcome but missed the actual major party vote by 6.6 per cent. Statistically, most of the 1948 election polls were only slightly in error, but the closeness of the election made the error seem to be a glaring one.

Careful analysis of the methods used by the polling agencies indicated that their failure to predict the 1948 election results was caused by (1) errors of sampling and interviewing and (2) errors of forecasting as a result of failure to evaluate properly the final decision of undecided voters and to take into account last-minute shifts in voting intention (Mosteller *et al.*, 1949).

Even when the polls succeed in questioning a cross section of socioeconomic, age, and sex groups that is representative of the population as a whole, their respondents may not represent the actual voting population unless they are screened on their intention to vote. The major sampling error committed in this case was the failure to eliminate respondents who were not likely to vote. Since 1948, pollsters have paid greater attention to the use of "screening" questions, to determine whether a respondent actually is eligible and intends to go to the polls.

The circumstances of the 1948 election were such that many voters either remained undecided until just before the election or made last-minute shifts in voting intention. In order to prepare their final reports and publish their results before election day, the major polls made no attempt to detect shifts of opinion during the last two weeks of the campaign. Thus their final predictions reflected public opinion as it had stood two or more weeks before the election rather than as it was when the voting took place. During this last two-week period many voters finally decided how to vote or made a last-minute shift in opinion. Since 1948, the polls have attempted to sample opinion much closer to election day.

The polls have improved their techniques in a number of other ways. Interviewing is done from four to ten o'clock in the evening, when more people are at home, and undecided voters are asked which candidate they lean toward at the present moment (Perry, 1960). These measures, in addition to refinements in sampling technique and the use of a secret ballot as described above, have greatly increased the accuracy of pre-election polls.

In 1956 the Roper poll forecast Eisenhower's popular vote within 0.7 per cent, and the Gallup poll missed by only 1.8 per cent. In the extremely close election of 1960, when Kennedy won by a margin of only 112,881 popular votes, the final Gallup poll results gave Kennedy a 1 per cent lead over Nixon. These figures were based on responses from all likely voters interviewed, showing Kennedy preferred by 49 per cent and Nixon by 48 per cent, with the remaining 3 per cent being undecided. Among those respondents who had made up their

minds, the Kennedy lead was 51 per cent to 49 per cent.

In the presidential election of 1964 the final poll-results concerning major-party votes were Johnson, 64 per cent; Goldwater, 36 per cent. The actual returns were Johnson, 61 per cent; Goldwater, 39 per cent. Combining the figures for the last four elections, the average miss is about 2 per cent—a high degree of accuracy in the social sciences.

An interesting sidelight on public opinion in presidential elections is shown in a study conducted at the time of the 1960 election in which the same subjects were asked before, on, and after election day to fill out rating scales on an ideal president, on Kennedy, and on Nixon, and to indicate their preference. During the period prior to the election attitudes tended to become more favorable toward the preferred candidate and less favorable toward the opposition candidate. Thus the candidates were perceived as increasingly different from each other. After the election, however, attitudes toward both candidates tended to become more favorable, and the candidates were seen as increasingly similar (Stricker, 1964).

The Use of Panels

Thus far we have been talking about survey methods in which respondents are contacted just once. There is another widely used method in which a representative sample is set up and its members contacted from time to time. This is an especially sensitive method for measuring small changes in buying behavior or voting intentions and for relating these changes to sources of communication such as radio or television programs listened to and newspapers or magazines read.

The use of panels presents the same problems as are encountered in one-time cross sections and introduces the further factor of possible loss of spontaneity on the part of the members. Some social scientists feel that panel members can become bored and careless in their replies or, on the other hand, they may come to look upon themselves as experts. There has been, however, no good evidence that these two methods give substantially different results.

PSYCHOLOGICAL FACTORS IN ADVERTISING

Since the livelihood of manufacturers and their employees depends on the public's opinions about their products, it is hardly surprising that a giant industry has developed to create favorable opinions toward particular products and services. Advertising is big business in our society. It is not, however, a modern phenomenon. Archeologists have discovered advertisements on the walls of the bath houses of ancient Pompeii.

Objectives of Effective Advertising

Advertising is a process of producing and circulating organized stimuli through mass media—newspapers, magazines, billboards, radio, television—in an effort to influence the buying behavior of potential customers. In order to accomplish its ultimate goal of maintaining or increasing sales, a good display advertisement or television commercial must meet four qualifications:

1. It must attract and hold attention.
2. It must deliver a sales message concerning the product and its advantages in a meaningful, believable manner.
3. It must convey favorable feelings toward the product advertised and/or the sponsor.
4. It must be remembered.

To a large extent these same objectives apply to the propagandist concerned with selling ideas rather than products.

Techniques of Advertising Research

During recent years, opinion surveys have been used with increasing success in market research and industrial relations. National advertisers spend large sums of money to increase or maintain the sales of their products. A two-page advertisement in color can cost over \$60,000 to run once in a magazine of high circulation, not counting the time required to prepare the copy and art work. Obviously, it is important to

know in advance whether an advertisement is likely to be effective.

Many psychologists are currently engaged in advertising research to pretest the effectiveness of advertisements. This work breaks down into two basic phases: the *quantitative*, or "nose counting," phase and the *qualitative*, or "motivational research," phase.

Quantitative research. One kind of advertising research is concerned with collecting facts about the customers or potential customers of the product in question. For example, who is now buying the client's own or competing products? How can present customers be classified in terms of age, income, sex, race, and education? What are the advertising media by which they are reached? To what extent do they buy and how much are they willing to pay? The methods of quantitative research tell *who* and *how many* buy but not *why* they buy. Research of this nature has been standard practice for over thirty years and does not require psychological training, although many psychologists are involved in it.

A good example of quantitative research is seen in a study of direct-mail advertising comparing the effectiveness of first-class mail and third-class or "junk mail" in bringing in subscriptions to a professional technical periodical. Ten thousand advertisements were sent first class and ten thousand third class. The first-class circulars brought 5.2 per cent returns, as against only 2.3 per cent for third class, showing the practical effectiveness of using first-class mail for this type of advertising (Cozan, 1960).

Qualitative or motivational research. Sometimes it is important to know not only *how many* people may be expected to buy a given article but also *why* they do so. The above study of direct-mail advertising, for example, gives no assurance that potential readers of confession magazines or news magazines would show the same differential response to first-class mail as did readers of the professional journal

which conducted the study. If, however, it could be shown that first-class mail appeals to some basic human motive such as the need for respect, it would be fairly safe to say that first-class mail advertisements would draw a greater response than third-class ones from almost every type of reader. Obtaining this kind of information is the job of qualitative or *motivational* research, which has become increasingly important in recent years. Advertising agencies today are very much concerned with studying the personality needs of large segments of the public, for these needs are important determiners of buying behavior.

One successful advertising agency made a study in which people were asked how fast they would like to drive if they knew they would not be arrested. The owners of one expensive automobile of "flashy" design gave speeds that averaged 123 miles an hour. The owners of another expensive automobile of simple and conservative design gave answers that averaged 73 miles an hour (Herzog, 1963).

People who have a strong drive for power are likely to want an automobile that will "leave the others behind." They want their automobile to be conspicuous and flashy. If they have the money to buy the car of their choice they will probably buy the one that best meets these needs. On the basis of motivational research the copywriter can decide what to say and the artist what to illustrate in order to make a product appeal to potential buyers.

In recent years some psychologists and market research experts have come to question the value of direct questioning in interviews. Many consumer interviews now use indirect methods whereby the customer is asked to project himself into a situation.

One such projective technique is the shopping list, used in a classic study of attitudes toward instant coffee. The investigator first performed a conventional survey on attitudes toward instant coffee. He found that the bulk of unfavorable responses fell into the general area of "don't like the flavor," an easy, socially acceptable answer which gets rid of the interviewer. He then devised two shopping lists, identical in every respect except one: where one list read, "Nescafe instant coffee," the other read, "1 lb. Maxwell House coffee

(drip grind)." When he asked housewives to "project" themselves into the situation and characterize the women who bought the groceries, he found that the instant coffee purchaser was characterized as lazy, spendthrift, a poor wife, and one who failed to plan well for her family (Haire, 1950).

It is held by many that the projective technique is more natural and that it circumvents the desire of most people to give socially acceptable answers. Thus it may yield more valid information than the conventional interview—though considerable skill and experience are usually necessary to analyze and apply its results. The various methods of quantitative and qualitative research all have their place in measuring consumer attitudes.

"Institutional" Advertising

In addition to extolling the virtues of their particular products, a number of businesses, chiefly large corporations, are making increasing use of "institutional advertising." This is advertising designed to create a favorable attitude toward the company itself or toward business in general. It may employ a number of special techniques (Pearlin and Rosenberg, 1952).

Elaboration of latent consequences. A commonly used technique of institutional advertising is to present corporation activities in such a way as to make them seem particularly beneficial to individuals, groups, or the nation as a whole. By-passing the fact that profit is, after all, the primary objective of any business, these advertisements play up activities of the company that are incidental to its pursuit of profit—providing employment for thousands of people, making a contribution to community resources and well-being, meeting the needs of some group, or even paying large taxes.

The beneficiary of corporation activity may be the individual or some subgroup, such as the farmers. Even small business has been termed a beneficiary of the operations of the big corporations. For example, Standard Oil stated in a radio commercial: "It is a company practice to buy locally whenever practical. . . . Its shopping list exceeds fifty thousand items—goods

and services like lumber, carpentry, shovels, paper, hose—everything it takes to keep a company like ours going. In totaling up the sales on these goods and services, the cash registers of thousands of local western business firms ring up more than one hundred million dollars every year! These are facts that explode an old myth to the effect that big business makes it tough for small business.” (Standard Oil Company, 1950)

Humanization. The large corporation, which of necessity is impersonal, is often presented as if it were a warm-hearted, friendly, folksy, generous, solicitous, hard working, intelligent, patriotic, and beauty-loving person. The Union Oil Company advertisement reproduced on page 594 is intended to build the image of a great corporation that is willing to go to the trouble and expense of preserving nature's beauty.

Denial. Big companies often use institutional advertising to deny such charges against them as monopoly, greed for profit, management by cliques, and other practices for which there is cultural distaste. For example: “United States Steel earned a profit of only five and a half per cent on its investment: or to put it another way, six cents on each sales dollar. This seems far from an excessive profit.” (United States Steel, 1947) Or by *conversion* the company may make the very aspects which are distasteful to many people appear in a favorable light—only big companies can be efficient, and expansion (made possible by large profits) benefits the nation.

Creation of ego involvement. Institutional advertising, as well as other propaganda efforts, tries to involve people personally in its cause. “You” or your local college or hospital may be a stockholder, so it is to your interest for the company to make profits. Or you may be taken “backstage” to see how the business operates and what its problems are so that you will develop a sympathetic interest.

Association or status contagion. A company may try to attain an aura of sanctity by making verbal associations with such values as family life, religion, and freedom. The company may be presented as a family, too, working for freedom as everyone must. Since this device must assume that the public will make the desired association between the corporation and the value, it is not often used unless it can be directly tied in with incidental benefits of the company. For example, it may be pointed out that wages paid by the corporation make possible pleasant family life for the veteran or give him the chance to get ahead.

Omissions. Since institutional advertisements deal more with ideas than with products, many omissions are necessary to avoid offending any particular group. Organized labor and the current administration are almost never mentioned, nor are class or race distinctions. Such advertising omits references to money-making as an objective and also to any unfavorable aspects of “bigness,” such as the possible effects of assembly-line work on personality. This is really a form of card stacking (p. 596).

Four examples of institutional advertising are shown on page 594.

TECHNIQUES OF PROPAGANDA

Propaganda, like education, is an attempt to influence people's thinking and behavior, but the goals and procedures involved are quite different. Education, at least as it is conceived of in this country, is concerned with developing

the individual's ability to think critically and reach his own conclusions, whereas propaganda may involve attempts to short-circuit reasoning through the use of strongly emotional appeals. The goals of true education are always to help

Although there are many kinds of institutional advertisements, all have one purpose—to give the reader a favorable impression of the company.

Some days we seed
a million trees before
your morning coffee break.

[illegible]

I AM SCHOOL DROPOUT. I CANT READ GOOD.
I CANT GET A JOB. HELP ME PLEASE

His conversion should make the 11th Reformation a little less open about their religious practices, he says. He says he has a "strong faith" in his religion, but he is not a "strong believer" in his religion.

With a lot of the help of many concerned citizens, we have programs to help low-income students. A few years ago, 20 students in New York started with a program. I've seen that group start growing, but through no fault of theirs, children aren't reaching their potential. Teachers who are doing a good job in the classroom have to take care of high school juniors. State programs are not enough.

It's a terrible irony. The American people are doing so well.

"Send me a man who reads!"
4 Lines In Your regional Page.

International Paper works with you to get the most out of your paper. We'll send you a man who reads. Our man will read your paper, find out what you need, and tell you what we can do to help. He'll read your paper, find out what you need, and tell you what we can do to help.

It's the only man who reads. It's the only man who reads. It's the only man who reads. It's the only man who reads. It's the only man who reads.

INTERNATIONAL PAPER

The Bell System helps thousands
of small businesses to get started,
to grow, to employ more people



Western Electric buyers often discuss order with president of one of the many small businesses which supply the Tel. System with a wide range of tools, parts and machines.

The Bell System's manufacturing and supply work, the Western Electric Company, bought new materials, supplies, equipment, etc., from nearly 40,000 other firms last year.

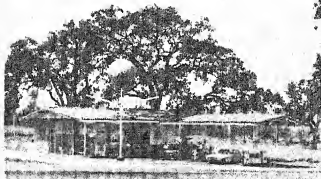
Nine out of ten were small businesses. They did a fine job for us and we appreciate it greatly. At the same time, our purchase of \$1,200,000,000 meant a great deal to them and their millions.

A large part of the money we received from our customers, while it made our own figures look bigger, went right out to help thousands of small businesses.

Our interests and theirs are inter-
twined. Their, too, because of jobs and
wages and business, have a vital stake in
anything that concerns the Bell System.

BELL TELEPHONE
SYSTEM

Owned by more than two million Americans



Why we didn't cut down the oak tree when we built this service station

You, as well as the company with its surroundings, are not a passive subject in the architecture of a service system.

[illegible]

But let me ask you, is it easier to give only if we accept our responsibility as a nation? You said I was going to tell you that if you made it, I would be it.

Now when you really hear that being a good neighbor is the responsibility where you do business in good business.

That's why we try to pay as much attention to our work and architecture as we do to the quality of our products.

We hope in doing this, some philosophy is to be used, which shows our love for the world and the future.

Union Oil Company of California

Order in all 50 States in the West **76**

Drive in at the Sign in the Midway and Again

the individual serve himself and society, while propaganda may be aimed at serving a special interest. This is not always the case, however; much propaganda is aimed at socially worthwhile goals such as safe driving or prevention of fire and disease.

It is difficult to estimate just how much we are influenced by propaganda. A substantial amount of the editorial material (material other than advertising) printed in newspapers is prepared by press agents, publicists, and public relations experts to present their clients' cases to the public in a favorable light. Such "slanted" stories have a far greater influence upon public opinion and action than does paid advertising.

Common Persuasive Devices

Propagandists have developed a number of devices with which to influence people to action. They know that in general it is not good (from their point of view) to have people think too deeply about an issue. Six common persuasive devices are *name calling*, *glittering generalities*, *plain folks*, *transfer and testimony*, *card stacking*, and *band wagon* (Miller, 1946). Another is the *appeal to prejudice*.

Name calling. Shakespeare overlooked the effectiveness of this device when he said that a rose by any other name would smell as sweet. A neutral object or person tends to become acceptable when given a pleasant name and unacceptable when given an unpleasant name. For example, when we refer to "John Doe, native son of the Golden West," most Californians will tend to feel favorably disposed toward this previously unknown person; but if we refer to the same native-born Californian as "a graduate of San Quentin," the effect is likely to be quite the reverse. Propagandists have rich vocabularies with which to describe persons, objects, or ideas, depending upon the interest they are serving and the effect they wish to create. The same individual may be described as a "one hundred per cent American" or an "isolationist"; as an "idealist" or an "impractical dreamer"; as an "enterprising businessman" or a "money-mad exploiter."

Name calling does not always take the form of such obvious labeling. In everyday conversation we often choose between two words which mean about the same thing but differ greatly in attractiveness. In the two lists which follow, the terms are roughly synonymous, yet what a difference in their connotations!

later maturity	old age
slender	skinny
scent	stink
inexpensive	cheap
thrifty	stingy
earthy	dirty

In one experiment forty terms were selected from the columns of the *Chicago Tribune* and forty terms used in the same connection from the *New York Times*. Subjects were asked to mark for each term L (Like), D (Dislike), or ? (No feeling about it). A score was then computed for each term by subtracting the number of D's from the number of L's given it, dividing this by the number of subjects, and multiplying the decimal by one hundred. Some of the comparisons are listed below (Sargent, 1939).

	Score	Difference
CT —radical	-53	
NYT—progressive	92	145
CT —government witch hunting	-38	
NYT—senate investigation	57	95
CT —regimentation	-53	
NYT—regulation	32	85
CT —Communist CIO leader	-68	
NYT—maritime leader	10	78
CT —labor agitator	-63	
NYT—labor organizer	12	75
CT —the dole	-35	
NYT—home relief	27	62
CT —farm dictatorship	-55	
NYT—crop control	-02	53
CT —loyal workers	60	
NYT—nonstrikers	08	52
CT —inquisitor	-22	
NYT—investigator	23	45
CT —CIO dictator	-72	
NYT—CIO chieftain	-33	39

The use of emotionally toned words is one way in which writers can editorialize and attempt to influence opinions even when they are supposedly "simply reporting events." We need to be especially on guard against such terms in news reports, since they can color our perceptions, and hence our judgments, without our realizing it.

Glittering generalities. When a political candidate calls upon voters to support the party that stands for "the high democratic ideals that have always brought pride to American hearts" or that will assure America a "glorious future," he is employing the technique of glittering generalities. When you encounter such a slogan, ask yourself, "What does it mean? Could this same slogan be used with equal accuracy to describe the opposition? What are the facts?" If we cultivate the habit of looking beyond glittering generalities for the facts, we are not so apt to be surprised when the police arrest "Honest John, the customer's best friend" for selling stolen goods.

Plain folks. This term covers a number of techniques whereby people are influenced to take a certain line of action because it is identified with the "common man." Political candidates usually see that wide circulation is given to pictures of them in old clothes playing with the dog or mowing the lawn or milking a cow. Such simple, honest, respectable activities are in no way related to the issues at hand but they make the candidate seem "a regular fellow" and therefore more appealing to the average citizen.

Transfer and testimony. The crux of transfer and testimony is the identification of a new object, idea, or personality with something venerated or respected. The picture of the big league ball player lighting a cigarette of a particular brand makes hero-worshiping youngsters not only want to smoke but want to smoke that particular brand. Candidates of both major political parties usually quote liberally from Washington, Jefferson, and Lincoln. Advertisers make cosmetics or lingerie appear more glamorous to feminine buyers by using endorsements by movie stars or society debutantes.

When endorsement comes from a disfavored person or party, the effect of the endorsement is usually negative. In a California election campaign, a Communist paper endorsed a certain pension plan. This fact was widely quoted by the opponents of the plan because most people have a tendency to be *against* anything the Communist Party is *for*, regardless of the merits of the measure itself. This technique of associating the opposition with a negative symbol has been called the "kiss of death" gambit.

Card stacking. A wide variety of devices for the warping and rigging of facts comes under this term. For example, a manufacturer of fountain pens might give every superior court judge in the United States a very fine fountain pen with his name on it and then have interviewers call on the judges to inquire what brand of fountain pen they used. In this purely hypothetical case the advertiser could claim: "With superior court judges, it's Scratcho, ten to one." Here the cards have been so neatly stacked that nobody need lie. But, as we shall see a little later, there sometimes is propaganda value in not stacking the cards too well—in actually including a point or two on the other side.

Band wagon. Many people like to be on the winning side regardless of the merits of the issues or the tactics of the winner. This is the band wagon effect that advertisers take advantage of when they say, "More Americans use Sudsowhiz than any other brand!" Although people are influenced both by what "the majority" believes and by what "experts" believe, the majority seems to carry greater weight.

In one study 300 high-school seniors, 300 college seniors, and 300 adults were asked to indicate their attitude toward seventy-five controversial statements concerning socioeconomic problems touching on the fields of education, politics, and ethics. Such statements were included as, "The installment plan of buying has done more harm than good to the stability of American economic life." Subjects were asked to check "Yes," "Uncertain," or "No."

One month later, one third of each of the three groups repeated the test with exactly the same conditions as on the first occasion, thus providing a control group. A second third of each group were this time

given questionnaires in which the majority opinion for each statement had been circled. The remaining third of each group were given questionnaires in which expert opinion (the composite vote of twenty individuals from public life or university faculties) had been circled.

Both majority and expert opinion influenced the subjects in each age group, and in each case majority opinion was found to be the more effective of the two. The greatest influence shown was in the case of the high-school students, where majority opinion was responsible for four times as many reversals of judgment as occurred in the control group (Marple, 1933).

Appeal to prejudice. One of the most potent techniques of the propagandist is that of appealing to prejudice. Interesting examples of the way that prejudices can influence judgment were the reactions of voters to the issue of Eisenhower's health during the 1956 presidential campaign. (Eisenhower had suffered a heart attack during his first administration.)

The Gallup poll showed that 70 per cent of Eisenhower voters thought that his health would be adequate to carry him through a campaign and a four-year term in office. Among Stevenson voters, the trend was sharply reversed, with only 23 per cent thinking the President's health was adequate.

Similar figures were obtained from a poll reported on August 30, 1944, several months preceding the death of President Roosevelt. At this time 84 per cent of the Roosevelt voters thought that his health was adequate to carry him through another four years of office, as opposed to only 47 per cent of Dewey voters. In both these cases Republicans and Democrats had equal opportunity to read the newspapers, listen to the speeches, and draw their own conclusions. Obviously their judgments were influenced more by political prejudices than by facts (Gallup, 1956). Minimizing the danger signs to convince oneself that one's candidate can make the grade is an example of reduction of cognitive dissonance (see p. 360).

Propagandists often take advantage of people's tendency to believe whatever is in accordance with their prejudices by employing a technique known as *flogging the dead horse*. That is, they begin a particular propaganda communication with eloquent arguments in support of a position already held by the proposed au-

dience. For example, a leaflet advocating a farm policy measure and directed toward members of a labor union might begin with a brief discussion of some labor issue, from a point of view favorable to labor. If the initial argument agrees with the opinions of the recipients, their attitudes are more likely to be influenced later by the material that follows than if the first statement is one they disagree with (Ewing, 1942). Also they are more likely to accept later communications on different topics, even when the source itself is questionable (Weiss, 1957).

Prejudiced individuals are more susceptible than others to propaganda that fits in with their beliefs, but ordinarily they are almost impervious to propaganda which opposes their prejudices. Not only do they tend to avoid reading or listening to ideas contrary to their beliefs, but they may be so skilled at evading the impact of such material that they actually misinterpret its message.

In looking at cartoons like the one on page 598, designed to make the reader identify himself with the prejudiced character and thus laugh at himself, the prejudiced person sometimes identified momentarily—but then he immediately would seek some point of difference and concentrate upon it, missing the point entirely.

Prejudiced persons also missed the point of antiprejudice propaganda by changing its frame of reference. In the case of dramas or stories illustrating a principle, for example, a prejudiced person might accept the principle but make exceptions for himself or for the particular minority group presented. Thus, after reading a leaflet advocating tolerance for Jews and ending with the message, "Live and let live," prejudiced persons often commented, "But it's the Jews that don't let you live; they put themselves outside the rule." Or the prejudiced person might regard the particular incident depicted as a good story but not true to life. After hearing a broadcast entitled *Belgian Village*, which told the story of a Jewish couple rescued from the Gestapo by villagers, listeners who had scored high on a conservative political attitude scale—which has a high correlation with prejudice toward minority groups—tended to discuss the program as an "adventure story" or "war story" and to ignore the special appeal for tolerance which had been presented along with it (Cooper and Jahoda, 1954).

A milder form of the tendency to be more susceptible to ideas which agree with one's own

beliefs appears in reactions to jokes. It has been found that members of a particular group enjoy jokes which attack out-groups more than jokes against their own group.

In a study of this phenomenon which took place on election day in 1964, 130 psychology students were given a booklet containing five jokes aimed at Goldwater, five aimed at Johnson, and five neutral jokes about politics in general. The students were asked to rate these on a nine-point scale from "not at all funny (1)" to "funniest joke I've ever heard (9)." They were also asked to explain each joke and to fill out a questionnaire covering their own and their father's party preference and candidate preference and their degree of interest in the election.

Results showed that jokes about the opposition candidate were regarded as significantly funnier, although comprehension of the jokes was not significantly correlated with candidate preference. Nor did interest in the election have a significant effect (Priest, 1966).

Factors in Effective Persuasion

Considerable research has been devoted to the principles underlying effective persuasion. What is it that makes a particular message successful or unsuccessful? Research in this area has focused on four main aspects: the message itself, the source of the message, the nature of the audience, and the situation in which the message is presented.

The message. The actual content of the propaganda message would logically seem to be the main determinant of its effectiveness. While it is true that many other factors play an important role, the message itself is indeed basic. Is it better to make a direct appeal or to "disguise" the message? Should one present only the desired point of view or acknowledge the existence of the "other side"? Which is more effective: a message advocating a very different position from that already held or one advocating a view only slightly different?

The directness of the appeal. The effects of direct and indirect appeals were compared in a study conducted in a manner similar to the Asch study of conformity to group opinion described on page 560.

Here is one of the cartoons used in studying the reactions of prejudiced people. Obvious as the point may seem to be, a person who shares Mr. Biggott's prejudices will not "get" it.



Mr. Biggott: "Hurry, operator, this is an emergency. I want a white, native-born, American policeman."

There were four experimental groups and one control group, each composed of twelve college students. Each subject was confronted with a group consensus that disagreed with him on twelve out of eighteen judgments as to the severity of criminal offenses. Subjects were presented with appeals to conform or to remain independent. Some were direct verbal appeals; others were indirect appeals, disguised as essays and presented as "a test of literary evaluation." In judgments on light offenses, more subjects were swayed toward conformity with the group than toward independence. The disguised appeal was more effective than was the direct appeal in swaying subjects toward conformity, although this form of appeal was not perceived by them as pertinent to their judgments (Garoi, 1964).

The presentation of both sides. There is evidence that propaganda is often most effective in bringing about opinion change when it presents at least some arguments for the opposing side, thus giving an appearance of objectivity (Lumsdaine and Janis, 1953). One study found that two-sided arguments were especially effective in convincing people who were initially opposed to a point of view, whereas with people who are already convinced of the propagandist's viewpoint, a one-sided presentation was most effective in reinforcing the belief (Hovland, Lumsdaine, and Sheffield, 1949). Further research is needed on the kind and amount of opposing arguments which are most effective.

Qualifying a positive argument does not have the same effect as presenting opposing arguments. This is brought out in the following study.

In this experiment, it was hypothesized that the impact of a qualified communication would hold up over time better than would that of an unqualified persuasive message. Opinions were given by college students at four different time intervals (up to forty-one days) after receiving qualified and unqualified written persuasive messages. Although the qualifications were forgotten more rapidly than the main points of the messages, the unqualified messages showed consistently greater persuasive impact than the qualified (Papageorgis, 1963).

The amount of opinion change sought. Asking for a large shift in attitude will cause more change than is obtained by making a more modest request of the audience. This is akin to Hitler's concept of the "big lie," which often succeeded better than less extreme, less spectacular propaganda.

In a study of the effect of amount of opinion change advocated, subjects first indicated their opinions about twelve issues on a seven-point scale and stated what kind of expert opinion on each issue they would respect most. A sample question went as follows:

1. a. All things considered, Washington was a greater president than Lincoln.

- _____ Agree strongly
- _____ Agree moderately
- _____ Agree slightly
- _____ Undecided

- _____ Disagree slightly
- _____ Disagree moderately
- _____ Disagree strongly

b. Of the following authorities which group's opinion would you respect most in reference to this question?

- _____ Teachers
- _____ Historians
- _____ Parents

Other items dealt with issues more closely related to modern life, such as the relative superiority of brains versus beauty in the choice of a wife, the likelihood of discovering a cancer cure within five years, and the amount of power that should be given the President of the United States. Each subject then read communications dealing with each of the twelve issues. The content of these messages depended on the individual's initial position on each issue. Each subject received "slight change" communications on some items, "moderate change" messages on some, and "marked change" material on still others. For example, if a subject's stand had been "agree strongly," a slight change communication would take the "agree moderately" position, a moderate change communication would take the "agree slightly" position, and a marked change communication would "disagree slightly." The communications were presented as the opinion of whatever authority the subject had indicated greatest confidence in.

After the communications were read, subjects filled out the questionnaire a second time. Their responses gave "clear-cut evidence that a greater change in opinion is produced by large than by small amounts of advocated change." (p. 259) This held true both for subjects whose original opinions were extreme and for those who were virtually neutral in the beginning (Hovland and Pritzker, 1957).

Requiring active participation. Having an individual pretend to espouse an opposite point of view also tends to shift his opinion toward that point of view. This fact is well known to the debater who, having been assigned the affirmative when he truly believes the negative of an issue, finds his position shifting as he prepares and practices his debate. There is also experimental evidence for this phenomenon.

Subjects paid 50¢ to write an essay advocating a position contrary to their beliefs were found to have changed their positions markedly in the direction of the opinion they had advocated in the essay. That the need

for dissonance reduction is operating in this situation is shown by the fact that subjects paid more were found to have been less affected. Those paid \$1.00 changed less than half as much as the 50¢ group, and those paid \$5.00 changed still less. Perhaps most interesting of all is the finding that those paid \$10.00 not only were not swayed from their original belief but held it more strongly than ever after writing the essay. This had been predicted from dissonance theory on the basis that these subjects would feel more justification for writing the essay and hence less need to reduce dissonance (Cohen, 1962).

Another study tested the prediction, again based on dissonance theory, that greater effort expended in defending an opinion contrary to one's own would result in greater attitude change than would passive exposure to the contrary opinion or minimal effort to defend it.

The experimental subjects were twenty college students who had indicated on a questionnaire earlier that they favored a numerical grading system over letter grades. They were told that they were participating in a study of verbal behavior and were asked to read a prepared speech as convincingly as possible. This speech favored letter grading in college courses. A delayed auditory feedback apparatus was used to create two conditions of effort. For Low Effort the delay between speaking and hearing was only 0.01 second, causing negligible effects on speech. The delay of 0.3 second used in the High Effort condition made it quite difficult to speak effectively. Attitude scales administered following the experimental sessions revealed a significant opinion change on the experimental topic, but no opinion change on three other topics from the original list used as controls. The difference between the High Effort and Low Effort conditions was in the expected direction but fell short of statistical significance. Another group, who simply listened to the speech and were asked to evaluate it for interest and convincingness, showed less opinion change than either experimental group (Zimbardo, 1965).

The source. The source from which a persuasive communication comes is an important factor in determining the effectiveness of the message. Numerous studies have shown that evaluation of and attitude toward the source of a communication affect the amount of opinion change induced.

Communicator credibility. The importance of the credibility of the source to which a

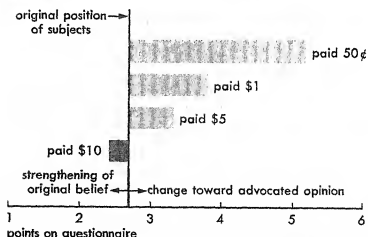
persuasive communication is attributed was brought out in a study in which high-school students were asked to listen to a recorded educational radio program, supposedly to judge its educational value.

As part of the program, a guest speaker gave a talk favoring highly lenient treatment for juvenile delinquents. He was introduced in three different ways for different experimental groups. In the "positive" version he was presented as a juvenile court judge. The "neutral" version identified him only as a member of the studio audience selected at random. For the "negative" version he was also presented as a member of the audience, but identified himself as a former juvenile delinquent currently out on bail.

An attitude scale on treatment of criminals was administered to the audience immediately after the talk. Seventy-three per cent of the students who had heard the talk presented from a positive source regarded the speaker as having given a fair presentation, as compared to only 29 per cent of those who had heard the identical speech from a negative source. Likewise, on the attitude scale administered immediately after the talk, the positive source group favored lenient treatment for criminals to a significantly greater degree than did the negative source group. On both these measures the neutral source group fell between the other two but much closer to the group which had listened to the positive communicator (Kelman and Hovland, 1963).

Consensus of experts. A message is more effective if it appears to be a consensus of ex-

EFFECTS OF ADVOCATING A CONTRARY POSITION



Based on Cohen, 1962

pert opinion than if expert opinion is represented as divided.

Eighty college students who a few weeks earlier had checked "no opinion" on the questions to be used took part in an experiment which demonstrated the effect of consensus of experts. The messages contained the premises of a syllogism in their subject matter but did not explicitly draw the conclusion. For example, one message, dealing ostensibly with nationalism, mentioned that Smetana was a nationalistic composer and later stated, "Somewhat less than half the experts on nineteenth-century music are of the opinion that music of nationalistic composers is romantic in style." Another message was identical in content except that the opinion on the style of nationalistic music was attributed to "all the experts." The implied conclusion, of course, was that Smetana's music is romantic in style.

Subjects were told that the study dealt with speech patterns and decision making and were asked to read three passages into a tape recorder, the third being either the one dealing with Smetana or a similar one implying that the Lapps are descended from Mongols. They then listened to a recording of "effective public speakers," after which they were asked to read the passages aloud again themselves. They were then asked to indicate the degree of their agreement with each of fifteen statements, the twelfth of which was the conclusion of the syllogism they had read. High consensus ("all the experts") messages resulted in a much greater degree of opinion formation than did low consensus messages (Weiss, Buchanan, and Pasamanick, 1964).

Evaluation of the source. Objective judgment is not the only factor contributing to the evaluation of the source of a communication. A recent study showed that not only the methods used by an expert but also his apparent certainty and even the pleasantness of his verdict affect others' confidence in his opinion.

A total of 240 college students were asked to read stories dealing with parents consulting a psychologist about their son's intelligence, medical aptitude, or adjustment. The students were asked to put themselves in the place of the parent as much as possible. In some stories the psychologist actually gave an intelligence or a medical aptitude test; in others the parent simply described his son's behavior and the psychologist interpreted this information. In half the stories the verdict was favorable: the son was highly intelligent,

showed unusually high aptitude for the medical profession, was well adjusted, or was highly creative. In the other half the son was reported to be subnormal intellectually, below the norm of medical students, on the verge of serious mental illness, or suffering from brain damage. Also, in half the stories the psychologist was "completely certain" of his judgment; in the other half he was "not completely certain." After reading a story, the students answered questions regarding their confidence in the psychologist: whether they would consult another man, whether they would return to the psychologist in case another problem arose, etc. More confidence was shown in the psychologists who had collected information rather than merely interpreted it, who had indicated complete certainty, and who had delivered pleasant judgments. For pleasant judgments, confidence was greater when the expert was certain. For unpleasant judgments there was very little difference in confidence, but the certain tester inspired more confidence than the uncertain tester, while the certain interpreter inspired less confidence than the uncertain interpreter (Di Vesta, Meyer, and Mills, 1964).

Timing of source identification. The effect of the source of a communication is also affected by the point at which the subject learns of the source.

A total of 498 high-school students heard twenty-minute talks designed to improve attitudes toward mental illness. All were given by the same woman and were identical except that in some talks she stated (falsely) at the beginning of the talk that she was formerly a mental patient herself, while in others she gave this information at the end, and in still others did not give it at all. Afterward, the students filled out rating scales evaluating neurotic people, former mental patients, mental hospitals, etc., on a number of scales, including such dimensions as worthless-valuable, dirty-clean, dangerous-safe, and sick-healthy. More positive attitudes were expressed by students who had heard late in the speech that the speaker was a former mental patient than by either of the other groups. Those not told that she was a former mental patient indicated more positive attitudes than those who had been given this information early in the talk (Husek, 1965).

Credibility of source and discrepancy of position. We have seen (p. 599) that greater change in attitude is generally brought about by communications which advocate more extreme

change. This holds true especially when the source is regarded as highly credible. However, when the same communication is attributed to a source having only moderate credibility, increased discrepancy between the position advocated in the message and the subject's own stand increases opinion change only to a point. Then, as discrepancy becomes greater, the amount of change in attitude decreases (Aronson, Turner, and Carlsmith, 1963).

A more recent study also investigated the relationship between amount of discrepancy and credibility of the source.

College students who received a communication purportedly issued by the U.S. Public Health Service (presumably a highly credible source) to the effect that there is no causal relationship between smoking and lung cancer changed significantly more toward this position than did students to whom the identical communication was presented as a statement of the Tobacco Industry Public Relations Committee, a group which obviously had a vested interest. Within both groups of subjects, students who had previously judged the position taken by the communication as more discrepant from their own stand changed significantly more toward it than did those who judged it as less discrepant (Choo, 1964).

Messages from a source regarded as highly credible may actually be misjudged as being closer to the subject's own opinion to begin with, whereas messages from a distrusted source are perceived as being more different from the subject's own position than they actually are. This was shown in two recently reported experiments. The first study, which had been conducted for another purpose, showed that subjects have a marked tendency to misperceive the message of a negative communicator by displacing it away from their own position. The second experiment was conducted to investigate this contrast effect further.

In the early study, conducted at a Negro college in Maryland just before the Supreme Court decision in favor of desegregation, tape recordings were used. Each of these purported to be an interview between a moderator and one of three different "guests," who were made to appear either highly negative or highly positive. All three presented an identical message, to the effect that even if the decision went favorably, it would

still be desirable to maintain some all-Negro colleges in order to preserve Negro culture and traditions—a point of view with which the audience disagreed. The negative communicator, a philanthropist given the name of Sprague, was presented as the pompous, opinionated head of a foundation which provided funds to Negro colleges and would withdraw these from institutions which did not agree with his opinions. The favorable communicators, said to be a professor and a minister, presented the message in a modest, sympathetic way, showing genuine concern for Negro problems.

At the close, 58 per cent of the students expressed agreement with the professor and 77 per cent with the minister, as opposed to only 23 per cent with Sprague. However, when asked which of three statements of position was closest to that of each speaker, they perceived the positions of the favorable communicators accurately but displaced Sprague's identical message away from their own views. Thus none of them thought that the professor or the minister had advocated having all the Negro schools remain all-Negro, but 41 per cent of them thought that Sprague had advocated this position.

The later experiment sought to explore the relation of this kind of effect to the strength of the subject's feeling toward the communicator. Two tape recordings of an exchange between a moderator and a guest on the topic of juvenile delinquency were heard by 151 high-school students. Preliminary questionnaires had shown the students to be neutral or mildly negative to the opinions expressed. Both recordings took the basic position that more clear-cut standards for behavior are needed by teen-agers. One advocated more definite laws, while the other stressed the need for parents to provide more adequate standards. The actual content in each case was ambiguous enough to be interpreted either as favoring more restrictions or as being appreciative of the good judgment of teen-agers. Half the students heard a negative communicator discuss laws and a positive communicator discuss parents' role, while the other half heard a positive "laws" recording and a negative "parents" tape. The positive communicator was presented as the director of a boys' camp, active in youth work, himself a father but young enough to identify with teen-age problems. In contrast, the negative communicator was a retired accountant, a bachelor with reactionary views and almost no contact with young people.

After hearing the tapes, the students answered questions on their reactions to the communicators, their perception of the content of the messages, and their

attitudes toward the issues discussed. They also were given six sets of statements, three for each message, and asked to choose which statement represented the speaker's position.

The tendency to displace the speaker's message away from the subjects' own stand was found to be directly related to the strength of their negative feeling toward the disliked communicator. Likewise, the tendency to misperceive the trusted speaker's stand as closer to their own, was a direct function of the strength of positive feeling toward him. Actual change in attitude, however, was almost identical for all those expressing positive feelings toward the communicator, regardless of the strength of those feelings (Kelman and Eagly, 1965).

Apparently, stronger positive feeling toward the communicator does not bring more attitude change than mildly positive feelings because of the simultaneous increase in the tendency to misperceive the message. When the feeling toward the communicator is negative, the subject tries to increase the distance between his view and that of the disliked communicator. One way of doing this would be changing his own view; he can accomplish the same thing, however, by displacing the message in a negative direction.

The audience. Not surprisingly, the personal characteristics of the recipients of a message play an important part in determining its effectiveness in bringing about opinion change. The individuals' attitudes, personality traits, fears, and anxieties all enter into their perception of the source as credible or untrustworthy as well as their perception of the message and their reaction to it.

The effect of ego involvement. A recent approach to the problem of how attitudes may be changed through persuasive communications takes into account not only the process of social judgment or evaluation but also the degree of personal involvement the individual feels in the particular issue being judged (Sherif, Sherif, and Nebergall, 1965). The basic attitudes of the normal person are evaluations that form part of his self-image, so that he is deeply involved in issues related to them. Some of the apparently contradictory results obtained in studies of opinion change may be accounted for by this factor.

For example, a fraternity leader would probably be unswayed by an anti-fraternity message that might be very convincing to a high-school senior who had not yet identified himself as a fraternity man. Ego involvement is, of course, even stronger in issues related to religion, politics, or family. The extent of ego involvement largely determines the degree to which the individual experiences tension or conflict when confronted with a point of view which differs from his own. It also plays a large part in his evaluation of such a divergent opinion.

A person's own stand on a social issue serves as an anchor for the evaluation or placement of statements about that issue. Some positions with regard to the issue will fall within the person's *latitude of acceptance*. This includes the position most acceptable to him plus other acceptable positions. His *latitude of rejection* usually includes a number of positions which he objects to, in addition to the position most objectionable to him. Between these two latitudes is the *latitude of noncommitment*, which includes neutral positions not classified as either acceptable or objectionable. The more deeply committed a person is on a given issue, the greater is the latitude of rejection in relation to the latitude of acceptance, with the area of noncommitment being very small. That is, if Mr. Smith identifies strongly with a cause, he tends to reject nearly all positions except his own, whereas Mr. Jones, who is less deeply committed, agrees with Mr. Smith but is willing to accept a wider range of opinions and feels neutral toward a number of positions which Mr. Smith firmly rejects.

The anchoring effect of the individual's own stand on an issue leads to an *assimilation* or *contrast effect* in his placement of communications about it. If the position presented in a communication does not diverge greatly from a man's own stand, he is likely to see it as nearer to his own position than it really is. This is an assimilation effect. On the other hand, if the position of a communication diverges far enough to fall within the individual's latitude of rejection, a contrast effect is likely to occur. That is, the communication will be seen as further away from the subject's own stand than it really is, as occurred in the Kelman and Eagly study already described. The range of as-

similation is very narrow if the individual is deeply committed to his stand. Among less committed persons the range of assimilation is greater and is affected by such factors as the structure of the communication, the order of presentation of the arguments, and the nature of the communicator.

In a large-scale study of placements of communications on the 1960 presidential election, 1237 college students in the Pacific Northwest and the Southwest served as subjects. They had previously filled in forms showing their latitudes of acceptance and rejection on the general election issue of Republican versus Democratic candidates. On the basis of their responses they were classified as highly involved (five or more rejections) or moderately involved (four rejections or less). Five experimental communications were prepared, covering the major issues of farm policy, labor, civil rights, foreign policy, and peace. One presented an extremely partisan Republican position and another an extremely partisan Democratic position. The remaining three presented the arguments of both parties on all issues and were identical except for the closing sentences, in which one communication stated that it would be better to vote for Democratic candidates, another stated that it would be better to vote for Republicans, and the third (the "fence-straddling" communication) merely urged the listener to vote, without advocating either party. The communications consisted of fifteen-minute tape-recorded speeches, all of which were delivered by the same professor of speech.

After listening to one of these tapes, subjects were asked to rate the position of the communication on a nine-point scale from "Extremely Republican" to "Extremely Democratic" and to state who the speaker reminded them of. Those who had heard the fence-straddling communication were also asked to predict for whom the speaker would vote. As was expected, the two extreme communications were correctly classified as such.

Highly involved Republicans and Democrats taking an extreme position showed a contrast effect in judging the moderately opposed communication. That is, highly involved Democrats judged the moderately Republican communication as more Republican than did any other subjects. Likewise, highly involved extreme Republicans judged the moderately Democratic message as more Democratic than did anyone else. Moderate Democrats whose latitude of acceptance extended to a point near that expressed in the moderately Republican speech

assimilated the communication toward their own stand, judging it as less Republican than did other subjects. Republicans whose latitude of acceptance extended through the position of the moderately Republican communication assessed it as more Republican than did extreme Republicans.

For the fence-straddling communication, the general trend was assimilation to the subject's own stand, with the greatest assimilation taking place among those with the most discrepant stands. This trend was more pronounced among the less involved, however. About half the members of both parties said that the speaker reminded them of a politician of their own party. Most Republicans predicted that the neutral speaker would vote Republican, but Democrats were somewhat less inclined to predict that he would vote Democratic, perhaps because the study was conducted in a predominantly Republican region and the Democrats may have been influenced by their fears as to how the election actually would go (Sherif, Sherif, and Nebergall, 1965).

Evidently, for maximum assimilation of a communication's position, the communication must be unstructured, permitting a variety of interpretations, the subjects must not be highly involved in the issue, and the communicator must be acceptable to the subject.

Fears and anxieties. Anxiety is one personality trait which influences the effectiveness of propaganda. This was brought out in a study of the anxiety level of subjects in relation to their attitudes on biological warfare.

Three weeks after their attitudes and their anxiety levels had been measured, subjects were divided into four experimental groups. Two groups read an article which ended with the explicit statement that biological warfare was not a super weapon and that the United States could work out an adequate defense against it, while the other two groups read the same article except for the last paragraph, which urged them to draw their own conclusions. Half of those reading the explicit article and half of those reading the nonexplicit article were led to believe it came from the *New York Times*; the other half of the subjects were told that it was from the *Daily Worker*. Immediately after reading the article and again six weeks later, the subjects filled out a questionnaire which appeared to be merely a test of their memory of the article but actually measured their degree of concern about biological warfare. A control group filled out questionnaires at the same time, without

having read the article. It was found that subjects high in anxiety showed greater opinion change than did those low in anxiety. The credibility of the source showed no relation to opinion change; the explicit article, however, brought about more change than the nonexplicit one (Fine, 1957).

Recent research shows that the arousal of fear and anxiety is an effective propaganda device if an escape route is provided. This route, of course, is the action desired by the propagandist. The effect of communications which arouse fear is closely related to how specific the recommendations are and how easy they are to carry out.

Yale seniors were asked to read a health bulletin on tetanus inoculation and then to fill out a questionnaire which included items on other kinds of inoculations as well as tetanus and items on the emotions experienced by the subject while reading the bulletin. Similar information was presented in both high-fear and low-fear bulletins but was made much more dramatic in the high-fear communication. All communications contained an identical paragraph on control of tetanus, stating that the university health service was making shots available to all students interested in taking them. Half of the bulletins (high-availability messages) gave specific directions as to the location of the health service, the hours at which shots were available, and just how to get one.

Those who had read the high-fear messages felt that inoculations were more important than did those who had read the low-fear bulletin and expressed stronger intentions of getting shots. However, all but one of the nine who actually went to get the shots had read the high-availability communications. Four of these had read the high-fear and four the low-fear message, the ninth was from the low-fear, nonspecific group. Thus fear arousal affects attitudes, but both fear and specific recommendations are needed to bring about action on the part of subjects (Leventhal, Singer, and Jones, 1965).

Another study of the effects of fear in conjunction with a readily available avenue of escape was conducted at the New York City Health Exposition.

Movies designed to arouse three levels of fear of lung cancer were shown to eighteen groups of fifteen to forty

subjects attending the exposition. The films depicted a young family whose father, a chain smoker, discovers he has lung cancer and must have one lung removed. The mild-fear version took the story only as far as the patient's trip to the operating room. The high-fear film included ten minutes of detailed scenes from the operation itself in full color. No film was shown to a control group. After the film (or a brief statement that none would be shown), chest X rays were recommended to the audience. It was pointed out that the X-ray unit, which had been clearly visible to the people as they entered, was right down the hall. Subjects were also given a booklet entitled "To Smoke or Not to Smoke" and asked to read it. When they had finished, they filled out a questionnaire covering degree of fear arousal, acceptance of the fact that smoking can cause lung cancer, intention to stop smoking, number of cigarettes smoked a day, desire to have an X ray, and length of time since an X ray had been taken.

In general, the results showed that fear facilitates rather than hinders the acceptance of recommendations. The subjects who actually had X rays were those who had reported greater fear, and a higher proportion of the subjects who saw the movies had X rays than did members of the control group. However, smokers in the film groups reported less desire to stop smoking than those in the control group. Smokers on the whole reported stranger intention to have X rays than did non-smokers. As compared to subjects who saw the low-fear movie, those who saw the high-fear film reported greater fear and stranger belief that smoking causes cancer but weaker intention to stop smoking. Thus the readily available chest X ray offered a quick and easy escape from fear, while the more difficult, long-term action of ceasing to smoke, which also was recommended, was not adopted in very many cases (Leventhal and Niles, 1964).

Arousing a higher degree of fear usually results in a greater change in attitude. For example, student nurses in whom greater fear was induced during a six-week study of tuberculosis showed a greater change in attitude toward the disease and measures used to fight it than did those subjected to a lesser degree of fear (DeWolfe and Governale, 1964).

The duration of exposure to a fear-arousing communication is related to its effectiveness, as shown in a study using technicolor sound movies of four durations (eight, sixteen, twenty-four, and thirty-two minutes) showing the vic-

tims of serious automobile accidents. The results indicated that greater duration of exposure produced greater concern and worry over driving and greater desire to take preventive action (Leventhal and Niles, 1965).

Another study investigated the effect of a strong fear appeal and a minimum fear appeal on students with different typical approaches to undesirable situations. Those who, on a sentence-completion test, showed a tendency to tackle difficulties energetically were called "copers," while those who usually avoided unpleasantness as much as possible were called "avoiders." Here the propaganda dealt with dental hygiene practices. The strong fear appeal had a greater effect on the "copers" than it did on the "avoiders," whereas the minimal fear appeal had a greater effect on "avoiders" than on "copers" (Goldstein, 1959).

Conformity and the measurement of propaganda effectiveness. Tendency to conform is a personality trait which may affect the results of questionnaires used to measure the effects of propaganda, whether or not it influences the effectiveness of the propaganda itself. Some individuals tend to answer "yes" to a greater extent than others and will answer questions in the affirmative even at the sacrifice of considerable consistency.

In a recent study of the effects of premature birth, Negro and white mothers of premature infants were questioned. Negro mothers gave many more "yes" answers than did white mothers, and it was noted that the same thing had occurred on preliminary personality tests. Apparently the "yes-saying" tendency was being measured as well as what the investigators were trying to measure. In this sample the Negroes were lower on the socioeconomic scale and had less education than the whites. This factor no doubt played a part in causing them to give affirmative answers to the white doctors, who had considerable prestige in their eyes (Hare, 1960).

The situation. The message and its hearer cannot be separated from the situation in which the message is presented. The order in which opposing arguments are presented has been found to be an important factor in determining which will be accepted. A situation in which the subject is distracted so that his full

attention is not focused on the message also affects acceptance of the message.

Order of presentation. The order in which arguments are presented may influence the judgment made on an issue, the most recent arguments tending to carry more weight.

Students read arguments based on actual testimony of witnesses in a trial. The case, which was genuine, concerned a bigamous marriage alleged to have occurred in 1800. During the first stage of the experiment, half the subjects (PD group) read two arguments in favor of the prosecution, followed by two in favor of the defense, while the other half (DP group) read two defense arguments followed by two in favor of the prosecution. In the beginning, the average opinion of both groups, as measured on a ten-point scale from "complete belief in innocence" to "complete belief in guilt" was about the same—slightly in favor of guilt. After hearing the arguments, however, the PD group was considerably more in favor of innocence, while the DP group felt more strongly that the defendant was guilty. In other words, the last word made the greatest impression (Anderson, 1959).

The effect of distraction. A recent experiment investigated the hypothesis that a persuasive communication arguing strongly against an opinion which the audience holds will be more effective when the audience is partially distracted from the communication so that they cannot think up counterarguments while listening.

Two films were presented, each containing the same arguments against fraternities. One film depicted a speaker delivering a speech. The other had the same sound track, but instead of showing the speaker, it made an irrelevant and highly distracting visual presentation. Fraternity members were influenced more by the distracting presentation than by the one showing the speaker. No difference between the two films was found among nonfraternity men. These results support the hypothesis (Festinger and Maccoby, 1964).

The effect of pleasurable correlated activity. A recent pair of experiments tested the hypothesis that food, as an extraneous gratification accompanying exposure to a persuasive communication, will increase acceptance, even though the food is not provided by the communicator.

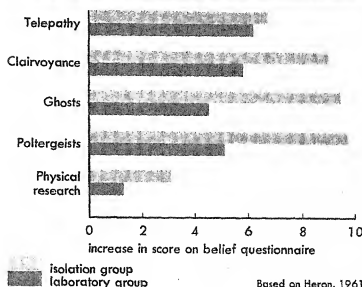
In two identical experiments college men were assigned on a random basis to three groups. They were exposed to either: (a) four persuasive communications while eating desirable snacks (corn chips and the like); (b) the same four communications with no food present; or (c) no relevant communications (control condition). The communications were articles ascribed to fictitious journalists; the subjects were told that their reading preferences were being assessed. To support this fiction, the closing questionnaire contained filler questions on how interesting the articles had been.

As an aid in determining the amount of opinion change, the experimental material was quantitative in nature. For example, one question in the preliminary questionnaire (and also the questionnaire filled out at the close of the experiment) was, "How many years do you think it will be before satisfactory progress is made in the search for a cure for cancer?" The results of both experiments indicated that more opinion change tends to be elicited under conditions where the subjects are eating while reading the communications (Janis, Kaye, and Kirschner, 1965).

Sensory deprivation and susceptibility to propaganda. The sensory deprivation experimentation discussed in Chapter 9 included investigation of susceptibility to propaganda. The issues involved were ones with which the subjects were not ego involved. In one study, experimental subjects were isolated under conditions of sensory deprivation (see p. 329). Only a low level of diffuse auditory stimulation was present, except during the controlled conditions described below.

After eighteen hours in isolation each subject was told that he might listen to a series of records if he wished. The nine records, played one at a time as the subject requested them, contained propaganda material in the form of arguments in favor of belief in telepathy, clairvoyance, ghosts, poltergeists, and psychical phenomena, read in a boring monotone. A control group heard the same records in an ordinary laboratory setting. At the beginning of the experiment and again after hearing the records, each subject filled out a questionnaire measuring his belief in the subjects discussed, as well as his interest in the topic of psychical phenomena and the degree of importance he attached to it. As indicated in the chart, both groups showed a significant change in attitude, but the change was significantly greater in the confined subjects. ▲ They also showed more interest

▲ SENSORY DEPRIVATION AND ATTITUDE CHANGE



in the topic and felt it was more important than did the controls. There was some evidence that these effects persisted for three to four days in some subjects, although no systematic follow-up was carried out (Heron, 1961).

Similar results were obtained in another study in which a less "spooky" topic was used.

After being confined for twenty-four hours under the most severe conditions of sensory deprivation, subjects (who had previously expressed neutral views toward Turkey on a questionnaire) heard a tape-recorded propaganda message favorable to Turkey. The same message was played to a control group in the confinement chamber. The posttest questionnaire showed eight times as much change in favor of Turkey on the part of the isolated subjects as on the part of the controls, whose change was negligible (Vernon, 1963).

Long-Term Effects of Propaganda

One of the main concerns of the propagandist is whether his efforts will have a lasting influence. Will those he has "converted" to his point of view still be with him a week—or six weeks—after presentation of his message? Or will they have forgotten it entirely and shifted back to their old way of thinking?

Spread of opinion change. One interesting "aftereffect" of propaganda presentations is the fact that opinion changes brought about by propaganda have been found to extend beyond the points actually included in the message. This spreading effect is more evident after a week has elapsed than immediately after the propaganda communication.

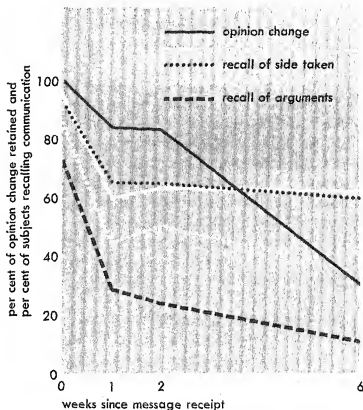
This was shown in a study in which 120 college students participated. At the beginning of the experiment they responded to a questionnaire which asked for their opinions on forty-eight statements, among which sixteen syllogisms were embedded. That is, the premises and conclusions of the syllogisms were separated and the premises interspersed in such a way that they did not appear to be parts of syllogisms. One of the syllogisms used was as follows: "Students who violate any regulation that has been made to safeguard the lives and property of other students will be expelled; the regulations against smoking in the classrooms and corridors were made to safeguard the lives and property of the student; students who violate the regulation against smoking in the classrooms and corridors will be expelled." Subjects read persuasive messages, each directed at one premise of a syllogism, and later responded to the opinion questionnaire again. There were significant changes in opinion not only on the premises specifically discussed in the persuasive communications but also on the derived conclusions, which had not been mentioned in the communications. A week later there was considerable loss of the immediately induced opinion change on the explicit issues, or premises, but much greater retention of the opinion change relative to the conclusions (McGuire, 1960).

The "sleeping effect." Sometimes a communication that seemed quite ineffective at the time it was presented may show increasing influence over a period of time while other communications, initially more effective, lose their influence. This effect, first demonstrated in an experiment carried out by the Information and Education Division of the War Department, is known as the "sleeping effect" (Hovland, Lumsdaine, and Sheffield, 1949). A "sleeping effect" was also found to occur in an experiment in which a communication was given and later deliberately discounted by the experimenter himself (Weiss, 1953). It can be explained thus: at first, the communication may

be discounted by the hearers as coming from a source with a propagandistic purpose. However, over a period of time the discounting factor may be forgotten more rapidly than the material itself: the ideas may be remembered but the source forgotten. The net result of this differential forgetting could be a delayed increase in the effect of the communication.

Decline of recall. The relationship between recall of the content of persuasive messages and the persistence of opinion change brought about by them was explored in a recent study.

The subjects were 191 education students, mostly women. All except the control group, who read no persuasive messages, took part in four sessions over a



Based on Watts and McGuire, 1964

◆ LOSS OF RECALL AND LOSS OF OPINION CHANGE

This graph compares the rate of loss of recall with the rate of decay of opinion change during the six-week period of the study. The amount of opinion change immediately after exposure was 2.53 on a 15-point scale. This was figured as 100 per cent, and the amounts of change shown on successive tests are plotted here as percentages of the original amount.

six-week period. At each session they read a 600-word message on a different issue, stating a position and giving three supporting arguments. All messages were logically presented and contained much documentary material, plausible "statistics," and the like. The sessions were timed so that the first occurred six weeks before the fourth session, the second two weeks before and the third one week before.

The issues were chosen from a number of topics on which education students had previously been asked to indicate their opinion, using a scale ranging from "definitely disagree" (1) to "definitely agree" (15). On the four issues selected opinion was homogeneous, with the mean responses ranging between 5.38 and 5.91. These means, rather than individual scores, were later used in computing amount of opinion change. Alternate forms of each communication were prepared, identical except that one was attributed to a positive source and the other to a negative source.

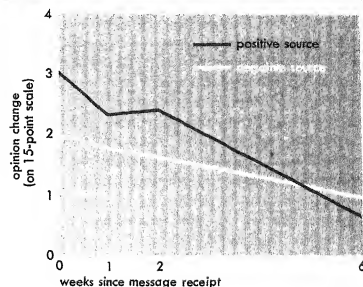
The subjects were told that the study was an attempt to develop tests for measuring reading comprehension and analytic thinking ability in future teachers and were asked to underline the briefest clause which expressed the main point of each paragraph. In the final session, after doing this with the fourth message, subjects completed an opinion questionnaire on the four issues, marking their degree of agreement with the stand taken in each message on the same fifteen-point scale. They also took four tests designed to measure their recall of various aspects of the messages themselves: (1) recall of the topic, (2) recall of the stand taken, (3) recall of the source, and (4) recall of specific arguments.

Both the persuasive impact of the messages and subjects' recall of their various aspects dropped fairly steadily over the six-week period. In fact, induced opinion change dropped 69 per cent in that time. As shown in the graph, however, the curve of loss of opinion change continued at the same rate during the entire six-week period. In contrast, the curve of recall of both content and source dropped more quickly at first and then tended to level out, as is typical of curves of forgetting in learning experiments. Evidently the decay of opinion change proceeded at a different rate from the decay of recall, indicating that opinion change is only partly dependent on retention of the content of a message.

One week after receipt of the message, those who recalled the topic were more influenced than those who could not recall it, but six weeks after the message those who could not recall the topic were more influenced than those who could recall it. This shows an interaction

EFFECTS OF POSITIVE AND NEGATIVE SOURCES

Immediately after exposure, opinion change induced by positive sources was half again as great as that induced by negative sources. The effects diminished at different rates, however, and by the end of the six-week period less change remained from the positive sources than from the negative ones.



Based on Watts and McGuire, 1964

between induced opinion change and recall of topics. Failure to recall a topic only a week after reading about it probably indicates that the message did not "get through" properly at the time, owing to poor attention or some kind of misunderstanding. On the other hand, in the case of those who failed to recall a topic after six weeks, the sleeper effect was evidently operating. Further evidence of this effect was shown when the opinion change induced by messages attributed to positive sources was compared with that induced by messages attributed to negatively regarded sources (Watts and McGuire, 1964).

Resistance to Propaganda

We have seen that a great deal of experimentation has been devoted to discovering the principles involved in the strengthening, weakening, and changing of opinions. Studies in this area have led some investigators to wonder if an individual can be "immunized" against propaganda material by being exposed to it in mild form, just as he can be immunized against a dis-

study of the relationship between reading and writing skills and that attitude questionnaires they filled out were simply to enable the experimenters to determine the effect of beliefs on performance level.

The first part of the study consisted of an "immunizing" session in which the subjects wrote an essay defending one of the truisms and read an essay defending a second truism. The conditions of reading and writing were varied to include two sets of independent variables: amount of participation (active or passive) and type of defense. In reading, the amount of participation consisted of passive reading or (active) reading with underlining. In writing this variable consisted of using a prepared outline (passive) or of working entirely on one's own (active). One type of defense in reading consisted of material that merely supported the truism; the other of material that included some counterarguments along with suggested refutations of them. One type of defense in writing consisted of writing an essay in support of the truism; the other of including some counterarguments and refuting them. Attitude measures were taken to determine the level of belief in the two truisms defended and on one control truism (to determine the mean level of belief with no immunization).

Data from the first session indicated that initial beliefs were indeed strong enough to justify calling them "cultural truisms." The mean level of belief at the beginning was 13.26 points on the 15-point scale used as a measure. The defensive conditions strengthened the beliefs still further, moving them up above 14 in most instances. The supportive defenses were slightly more effective than the refutational ones in strengthening initial beliefs.

The second part of the study was designed to test the effects of the different immunizing conditions after the beliefs had been subjected to strong attack. Each subject read propaganda pieces in the form of essays attacking the two previously defended beliefs and one additional truism (to determine the effects of attacking a belief when no immunization had been given). He then filled out the attitude questionnaire again. At the close of the experiment, of course, subjects were informed of its true purpose and were warned against believing the arguments against the truisms.

As the chart shows, the beliefs proved highly vulnerable to the attacking propaganda. In fact, the supportive defenses had virtually no immunizing effects, but the refutational defense material did give some immunization. ▲

When the different participative conditions were compared, it was found that unguided active participa-

tion was clearly less effective in providing immunization than was passive participation. Reading had a greater strengthening effect than writing, and an even more pronounced immunizing effect. Passive reading provided greater strengthening and immunizing effects than did reading with underlining. Similarly, writing from a supplied outline was more effective in both respects than writing without an outline.

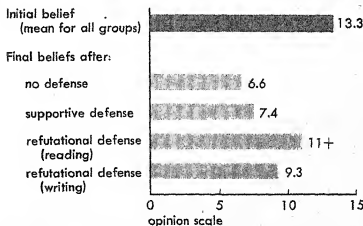
These findings were in accord with the experimenters' expectations. They had reasoned that people characteristically defend their strongly held beliefs by avoiding exposure to contradictory information. Since the person has little occasion to develop real defenses to such beliefs, he is unprepared when the necessity does arise; he is thus highly vulnerable to persuasion.

In general, the study showed that material designed to immunize against propaganda should contain counterarguments with suggested refutations. It showed further that the immunizing effect cannot be predicted from the immediate strengthening effect of the material, since supportive arguments, which had the greater strengthening effect, provided little resistance to the propaganda that came later (McGuire and Papageorgis, 1961).

The immunizing effect of exposure to counterarguments extends to strengthen resistance to other counterarguments.

In one study seventy-three college students participated and two of the truisms used in the study described above were employed—those dealing with chest X rays and tooth brushing. As had happened previously,

▲ EFFECTS OF IMMUNIZATION AGAINST PROPAGANDA



Based on McGuire and Papageorgis, 1961

those subjects who were exposed to propaganda without having been immunized showed a substantial reduction in the level of their beliefs. Immunization had a direct strengthening effect on the beliefs and also greatly increased resistance to the strong counterarguments presented in the second session. In this study all immunization consisted of counterarguments presented with refutations. It was found that such immunization created strong resistance not only to the counterarguments used but also to different ones.

At the close of the experiment, subjects were asked to rate several counterarguments as to quality and credibility and also to list arguments in support of their original beliefs. Those who had been immunized rated the strong counterarguments, both those they had been exposed to and different ones, as lower in quality and credibility than did the non-immunized subjects. Furthermore, the immunized subjects tended to think of more supporting arguments, although this tendency was not statistically significant (Papageorgis and McGuire, 1961).

In summing up the results of these studies, the investigators reasoned that the refutational defense material, by threatening strongly held beliefs, stimulated the individual to marshal his defenses and become more receptive to supportive material. On the other hand, the individual who was subjected to supportive material alone probably tended to regard it as belaboring the obvious and hence did not take it as seriously or assimilate it as well. They suggest that the defense-provoking threat of the refutational immunization material, rather than the mere fact that it refutes counterarguments, may be its principal value in strengthening beliefs.

A further study demonstrated that the resistance built up by refutational defense persisted longer than that built up by supportive defense materials. The same study revealed that refutational defense did not reach its maximum effectiveness in conferring immunity until several days after the material was originally presented and showed the same delayed-action effect against new counterarguments (McGuire, 1962).

Brainwashing

No discussion of propaganda and persuasion would be complete without mention of the much misunderstood technique called "brain-

washing" (Schein, 1957). This procedure was employed on soldiers captured by the Red Chinese during the Korean War. This enemy effort had two phases, *physical* and *psychological*.

The physical stress phase. The first phase of brainwashing commenced at the time of capture and consisted of long and exhausting marches to the north of Korea, lasting from one to six months. Although beatings were rare, the deprivation of bodily needs was great. The prisoners were told that since the United Nations had illegally entered the war they were all war criminals and could be shot were it not for the kindness of their captors. Although the prisoners were for the most part wounded or ill, they received no medical care. Those who fell during the marches were left to die unless helped by their comrades. It was pointed out that the Chinese soldier got no better treatment and that poor facilities and food were the result of United Nations bombings. The captured men were assured that life would get better once they reached camp, where they would be treated as "students" and would be taught the "truth" about the war.

The psychological stress phase. This phase started upon assignment to a permanent prison camp. There the prisoners were subjected to a prolonged barrage of highly persuasive propaganda while under the extreme stress of imprisonment, loneliness, hunger, fear, threat of ostracism, and uncertainty about ever being released. Physical torture was rarely used by communist captors, since while it may cause a person to say he believes almost anything in order to stop the pain, he is likely to continue to believe as before. Brainwashing, on the other hand, although not physically painful, may cause a genuine change of conviction through its prolonged, relentless mental pressure.

In the prisoner-of-war camps, the brainwashing took place under conditions that some psychologists have called DDD—debility, dependency, and dread (Farber, Harlow, and West, 1957). Physical conditions in the prisons were designed to keep the men in a weakened state. The prisoners were, of course, completely dependent upon their captors for food and other physical necessities and for many psychological

CHAPTER SUMMARY

necessities as well. Closely bound to this dependency was their constant dread of physical punishment, prolonged incarceration, and eventual mental capitulation.

These conditions of debility, dependency, and dread are known to reduce the normal level of response and to impair the symbolic processes. Furthermore, they tend to cause disorganization of the self concept. Thus the individual's mental state tends to be disoriented and his normal equilibrium and self-confidence are upset, with the result that he is more vulnerable to constantly reiterated ideas and may eventually accept them. What is more, the Communists were continually applying their considerable knowledge of the principles of conditioning and learning theory to produce the greatest possible learning of the desired new concepts.

A great outcry was raised in many American publications about the disgraceful defection of American prisoners to the enemy. However, the percentage of Americans who actually collaborated with the Communists or really experienced any basic change in their beliefs was quite small. A study of 235 Air Force personnel who had been imprisoned by the Communists in China and Korea revealed that attempts to indoctrinate them had been largely ineffective (Biderman, 1957). Only about 15 per cent of all American prisoners of war capitulated, usually without realizing how greatly they were aiding the enemy's psychological warfare campaign by so doing. While only 5 per cent were courageous enough to refuse any capitulation or cooperation, the vast majority (80 per cent) managed to maintain their own beliefs by cooperating as little as possible and sitting by, trying not to arouse enemy antagonism but at the same time not giving in (Segal, 1957).

Brainwashing is still practiced in Chinese prisons and, as described by Western civilians subjected to it at a later date than the Korean War, includes a strong emotional assault during the interrogations following arrest. Cellmates exert pressure upon the prisoner to "confess." When he is at the breaking point, calculated kindness is employed in an effort to bring a quicker confession of crimes as seen from "the people's standpoint" (Lifton, 1956). If the prisoner does give in, he is subjected to intensive "reeducation" before finally being released.

Like other forms of communication, *mass communication* requires feedback to function effectively. Both *public opinion polls* and *advertising research* represent efforts to establish dependable feedback for mass communication. Directors of public opinion surveys are faced with two basic problems: getting a representative sampling of the public and getting honest, direct answers to their questions. They must avoid biasing or predetermining an answer, failing to determine sufficiently the direction of response, and exceeding either the ability or the willingness of the respondent to answer. The accuracy of opinion polls has increased greatly in recent years, as errors of sampling, interviewing, and forecasting from the data have been overcome. Improvements in technique include the use of a secret ballot, evening interviewing, and sampling opinion much closer to election day. For some purposes *panels* of respondents are used.

Advertising is a process of producing and circulating organized stimuli through mass media in an effort to influence buying behavior. To be effective, it must attract and hold attention, deliver a sales message, convey favorable feelings, and be remembered. To determine the effectiveness of their efforts, advertisers conduct *quantitative* research to find out who and how many buy a product and *qualitative* or *motivational* research to discover the personality needs that influence choice of one product over another. In the latter, the indirect methods of the *projective technique* have had good results.

Institutional advertising employs a number of special techniques to create favorable attitudes toward a particular company or toward big business in general. These include: elaboration of latent consequences, humanization, denial and conversion, creation of ego involvement, association or status contagion, and omissions.

Like advertising, propaganda attempts to influence people's thinking and behavior. Both propagandists and advertisers make frequent use of the persuasive devices known as *name*

calling, glittering generalities, plain folks, transfer and testimony, card stacking, band wagon, appeal to prejudice, and flogging the dead horse.

Research has established a number of principles governing the effectiveness of persuasion. The actual content of the message is basic but may be more effective when disguised. There is also evidence that propaganda is frequently more effective when it presents at least some arguments for the opposing side, giving an appearance of objectivity. Asking for a large shift in attitude will usually cause more change than is obtained by making a more modest request. When the source is perceived as authoritative, the message is better received. In fact, it is actually perceived differently when it comes from a highly credible or admired source than from a less credible or disapproved one. An *assimilation effect*, or tendency to misperceive a trusted speaker's stand as closer to one's own than it really is, occurs in direct proportion to the strength of favorable feeling toward the speaker. A *contrast effect*, or tendency to displace the message away from one's own stand, occurs when the speaker is unfavorably regarded. The degree of the subject's ego involvement in the issue likewise affects his perception of persuasive messages, with a high degree of involvement leading to a narrow assimilation range. Thus the effect of discrepancy between own stand and communication is tempered by other factors, including the extent to which the communication is structured, the credibility of the source, and the ego involvement of the subjects.

Anxiety is a personality trait which influences the effectiveness of propaganda. Subjects high in anxiety tend to show greater opinion change than do those low in anxiety. The arousal of fear and anxiety is an effective propaganda device if an escape route is provided, with high degree and long duration of fear producing greater willingness to comply with the suggested procedures. However, personality structure influences the effects of fear, with strong fear appeals being more effective with "copers" than with "avoiders." A tendency to conform is another personality trait which may

result in misleading answers to questionnaires used to measure the effects of propaganda, whether or not it influences the effectiveness of the propaganda itself.

The message and its hearer cannot be separated from the situation in which the message is presented. The order in which arguments are presented may influence the judgment made on an issue, the most recent arguments tending to carry more weight. Partially distracting the audience so that they cannot think of counterarguments adds to the effectiveness of communications arguing strongly against an opinion the audience holds. Pleasurable correlated activity, such as eating, increases the effectiveness of persuasive communications. After a prolonged period of isolation and sensory deprivation, susceptibility to propaganda messages is heightened.

Opinion changes brought about by propaganda have been found to extend beyond points actually made in the message—more so after a week has elapsed than immediately after the communication. Furthermore, propaganda which seems initially ineffective sometimes shows increasing influence over a period of time. This is known as the *sleeping effect* and is accounted for by the fact that the source of the information, which may originally be discounted as propagandistic in nature, is forgotten more rapidly than the material itself.

Some immunization to propaganda, even to attacks on cultural truisms, seems to be possible. The person who is familiar with some opposing arguments and refutations for them has an advance basis for withstanding attempts to undermine his beliefs. The immunizing effect of such material tends to become generalized.

The intensive form of propaganda called *brainwashing*, practiced on prisoners of war by the Red Chinese during the Korean War, involved a physical stress phase and a psychological stress phase. It usually took place under conditions of DDD—debility, dependency, and dread—which reduce the normal level of response, impair the symbolic processes, and disorganize the self concept.

Reference Manual

A

Basic Concepts in Statistics

B

Frontiers in Psychology

Section A Basic Concepts in Statistics

Statistics provide us with a method of reporting and evaluating the results of psychological research. Just as the student of business administration must learn accounting in order to derive the full meaning from sales and profit figures, the psychologist must employ statistical methods and formulas in order to draw valid generalizations about human behavior and mental processes from his observations. Complicated as these methods may seem at first glance, they are really ways of reducing a mass of data to terms that the mind can grasp.

The psychologist, like any other scientist, devotes a great deal of his time to making observations. These observations are the raw material with which he works. Having made a series of observations, he tries to integrate them into a theoretical framework or use them to find the solution to a particular problem or the answer to a question. This usually involves various statistical procedures. The first step is to put the observations into numerical form so that they can be handled statistically. This is done by means of *psychological measurement*.

PSYCHOLOGICAL MEASUREMENT

Measurement in psychology, as in other fields, may be defined as assigning numbers to persons, objects, or events according to certain rules. In the physical world, measurement is usually accomplished by arbitrarily deciding on some standard unit, such as the pound or the inch, and finding out how many of these are contained in the object being measured.

In psychology, the task of measuring is much more difficult. First of all, it is difficult to define a standard unit. What, for example, is a standard unit of introversion? Or of racial prejudice? Secondly, even when a unit can be defined, there is a problem of finding out how many units are "contained" in that which is being measured. The psychologist must often settle for a lower level of measurement, such as determining which of two persons has *more* of a certain trait, without specifying *how much* of the trait each person has. The statistical operations which can be performed on psychological data

depend upon the level, or *scale*, of measurement. Although it is possible to conceive of an unlimited number of scales, it is common practice to differentiate among four types: *nominal*, *ordinal*, *interval*, and *ratio* (Stevens, 1946).

The Nominal Scale

The lowest level of measurement—that is, the level of measurement which imparts the least information—is the nominal scale. Numbers are used only to distinguish one individual or group from another. Examples of the use of the nominal scale are the numbering of football players, of congressional districts, and of license plates. The numbers used do not represent an *amount* of anything, nor does a high number stand for more of something than a low number. The numbers merely differentiate one individual or class from another. Some argument

might be made as to whether this is measurement at all, but it does fall under our definition, "assigning numbers to persons, objects or events according to certain rules." The essence of measurement on the nominal scale is *classification*. We might classify registered voters by assigning to them the number of the congressional district in which they live. Since there are many persons in the same congressional district, each number would be assigned to more than one individual. In some uses of nominal measurement, there is only one person per class. This is the case with selective service numbers or with the numbering of football players. While a particular category may contain more than one individual, no individual may be assigned to more than one category. A person cannot be in two congressional districts, nor can a football player have two numbers. Thus in nominal measurement persons, objects, or events are put into *mutually exclusive* categories.

The Ordinal Scale

Measurement on the ordinal scale not only distinguishes one individual from another, but also tells us whether a person has more or less of the trait being measured than other persons in the group. An example of the ordinal scale is the order in which runners cross the finish line in a race. The runner who finishes first is faster than the runner who finishes second, who in turn is faster than the runner who finishes third, and so on. By noting the order in which the runners cross the finish line, we have measured their speed on the ordinal scale. Ordinal measurement, however, gives no information as to the amount of difference between two individuals in the trait being measured. Thus, although we know that the first-place runner is faster than the second-place runner, we do not know how much faster. Nor do we know whether the difference in speed between the first- and second-place runners is the same as between the third- and fourth-place runners. Ordinal measurement is used quite frequently in psychological research, because psychological traits are often difficult to measure on a higher scale.

The Interval Scale

The interval scale has all the properties of the nominal and ordinal scales and in addition the property of equal units. This means that equal differences in scores represent equal differences in what is being measured. An example of the interval scale is the temperature scale, as found on a thermometer. The difference in temperature between 99 and 100 degrees centigrade is the same as the difference between 49 and 50 degrees centigrade, or any other difference of one degree centigrade. In other words, the *intervals* are equal throughout the scale. If temperature were measured on an *ordinal* scale, we could tell only that a given object was hotter than certain objects and colder than others. By measuring temperature on an *interval* scale we know not only that one object is hotter or colder than another, but also *how much* hotter or colder.

Measurement on the interval scale does not, however, give us information as to the ratio of two objects with respect to the quantity being measured. Thus, it would be incorrect to say that an object whose temperature is 50 degrees centigrade is twice as warm as an object of 25 degrees. This statement would be correct if 0 degrees centigrade were an absolute zero—that is, if an object at 0 degrees had no warmth at all. In fact, however, absolute zero occurs at -273 degrees centigrade. Thus, an object at 25 degrees is really 298 degrees warmer than absolute zero, and an object at 50 degrees is 323 degrees warmer than absolute zero. The second object, then, is clearly not twice as warm as the first.

The Ratio Scale

The ratio scale is the highest level of measurement. It has all the properties of the lower scales, and the additional property of an absolute zero as its point of origin. This is the scale upon which the common physical measurements of length, time, and weight are made. Since the scale has an absolute zero, statements of ratios are meaningful. Thus, a six-inch line is twice as long as a three-inch line; a two-pound object is one-fifth as heavy as a ten-pound object, and so on.

The properties of these four common measurement scales can be summarized as follows:

Properties	Nominal	Ordinal	Interval	Ratio
Classification	x	x	x	x
Order		x	x	x
Equal units			x	x
Absolute zero				x

As can be seen in the table, each of these levels of measurement has all the properties of lower levels, plus an additional property. The higher the level of measurement, the more information is given about the attribute being measured. It is for this reason that psychologists, as well as other scientists, strive to use the highest level of measurement possible in a given situation.

THE USE OF DESCRIPTIVE STATISTICS

Once data have been collected by means of psychological measurement, descriptive statistics are used to summarize them so that conclusions may be drawn. A descriptive statistic is a number which stands for a series of measurements collected on a group. There are a great many different statistics used in psychological research. The choice of a statistic will depend both upon the measurement scale used and the information wanted.

Since different statistics require different numerical operations, the level of measurement must be a consideration in determining which statistic to use. The higher the level of measurement, the more numerical operations are possible. We have seen that measurement on the nominal scale has only the property of classification. The numbers which represent the various classes are only labels; they do not express quantity. It would therefore be meaningless or even misleading to add them, subtract them, or perform any other numerical operation. Ratio scale data, on the other hand, may be added, subtracted, multiplied, and divided.

The other consideration is the information which the statistic is intended to convey. The three types of information most commonly needed in psychological research are *central value*, *variability*, and *correlation*. The basic

concepts involved were introduced in Chapter 5. Here we shall examine them in greater detail and include some actual computation.

Measures of Central Value

Suppose a psychologist is studying the attributes of various religious groups. He would first have to classify his subjects by religion. His measuring instrument might be a questionnaire asking each subject to state his religion. If he succeeds in putting each subject into one and only one class from a list of several religions, he has measured their religion on the nominal scale. Suppose he now wants to describe his sample by stating the religion of the "average" subject. There are several statistics that indicate a group's average measurement, but since he used only nominal measurement, he must use the central value statistic which is applicable to the nominal scale. This is the *mode*.

The mode. The mode of a group of nominal measurements is the class with the most members. For example, in the table below, the mode is Protestant since more subjects in the group are of the Protestant religion than any other religion.

Religion	Number of Subjects
1. Catholic	37
2. Protestant	88
3. Jewish	17
4. Other	5

Since a table such as this shows how the individuals are distributed among the various classes, it is called a *distribution*. We often refer to a group of measurements as a *distribution*.

Numbers are often used for convenience in nominal measurement, especially if there are many classes. Using the numbers above, we would say that the mode is 2. Since the measurement is on the nominal scale, the assignment of numbers is purely arbitrary. Once assigned, of course, the same number must be used to represent the same class throughout the analysis.

The median. If we have at least ordinal measurement, that is, if the classifications can be put in order so that each class represents more of what we are measuring than those classes following it, another central value statistic may be used to describe the group.

Suppose we wanted to summarize the ranks of a group of army officers attending a military conference. By noting the insignia on their shoulders we could measure their ranks. Since these measurements can be put in order, we have measurement on the ordinal scale. In this table every rank is higher than the ranks below

Rank	Number of Cases
7. General	2
6. Colonel	3
5. Lieutenant Colonel	6
4. Major	9
3. Captain	10
2. First Lieutenant	8
1. Second Lieutenant	12
	50

it and lower than the ranks above it. Higher numbers have been used to label higher ranks to preserve this order. These numbers are arbitrary in some respects, since we might just as

well have used 99 for General, 98 for Colonel, and so on. Or, we might have used 17 for General, 14 for Colonel, some lower number for Lieutenant Colonel, and so on down to the lowest number for Second Lieutenant. As long as the higher of two numbers always stands for the higher of the two ranks, the ordinal property is preserved.

A measure of central value that we can use for these data is the *median*. The median is the number which splits the distribution in half, so that half the cases are higher and half are lower. Since there are 50 cases altogether, the median is the rank which 25 cases are below and 25 are above. We see from the table that 20 officers are First Lieutenant or below and 20 are Major or higher. Since it is impossible to split the distribution exactly in half, we come as close to it as possible and say the median is 3—Captain.

If we wished, we could also use the mode as a measure of central value. The mode of this distribution of measurements is 1, since there are more second lieutenants than any other rank. The choice between these two statistics will depend upon what information is wanted. If we use the mode to represent all members of the group, we will be exactly right more times than if we use any other value. However, if we want the central value which will be too high as often as it is too low, we will choose the median. To state this another way, suppose we knew only that an officer was a member of this group and we wanted to guess his rank. If we used the mode, we would have the highest probability of being exactly right. If we used the median, the probability of guessing too low would be the same as the probability of guessing too high.

The mean. If measurement is on the interval scale or higher, still a third measure of central value may be used. This is the *mean*.¹ The mean is calculated by adding together all the measurements and dividing by the number of cases.

If we want to know the average verbal comprehension ability of a group of high-school students, we can begin by measuring their verbal

1. The exact term is *arithmetic mean*, as distinguished from other means, such as the geometric mean. Since these other statistics are seldom used in psychology, *arithmetic mean* is usually abbreviated to *mean*.

comprehension with a test. If a test has been carefully constructed, we usually assume that it yields measurements on an interval scale. Here, we will assume that equal differences in test scores stand for equal differences in verbal comprehension. Suppose the scores on the test, arranged in order from highest to lowest, are as follows:

Student	Verbal Comprehension Score
John	20
Mary	18
Shirley	18
Peter	17
Alice	16
Nancy	13
Henry	13
Diane	12
Douglas	11
Sam	11
Harvey	10
Jane	10
Barbara	10
David	9
Roger	7

The first step in calculating the mean is to add all the scores. The sum of all the scores is denoted by the symbol, ΣX , which is read, "sum of the X's." The capital Greek letter sigma (Σ) stands for "the sum of . . ." The capital letter X stands for each of the scores in turn. By adding up all the scores, we find that $\Sigma X = 195$.

The second step in computing the mean is to divide ΣX by N , the total number of cases. The formula for the mean is:

$$\bar{X} = \frac{\Sigma X}{N}$$

where \bar{X} stands for the mean. This formula is read, "The mean is equal to the *sum* of the X's divided by the *number* of X's." Since there are 15 scores altogether, we can calculate the mean as follows:

$$\bar{X} = \frac{\Sigma X}{N} = \frac{195}{15} = 13$$

Thus, the mean of the above scores is 13. That is, the average verbal comprehension of this group of students is 13.

The verbal comprehension scores are interval data, so the mode, median, or mean *can* be used. Each of these central value statistics represents a different kind of "best guess."

If our purpose is to be exactly right most often, we would use the mode. More persons had a score of 10 than any other score, so 10 is the mode. In guessing the scores of individuals in the group, we would be exactly right 3 times if we guessed each student's score at 10. Of course, we would be wrong by some amount in guessing the scores of the other 12 students. In this case, too, we would usually be guessing too low, since 10 students have scores above the mode and only 2 have scores below it. If we wanted a guess that was too high as often as it was too low, we would use the median score, 12. This guess would be exactly right only once, but would be high 7 times and low 7 times.

Thus the median is in the "middle" of a distribution of scores in the sense that the same *number* of scores are on both sides of it. But suppose that the three high scorers, John, Mary, and Shirley, had each gotten a score of 100. The median would still be 12, but this guess would be 88 points too low in three cases. The median would be too low the same *number* of times as it was too high, but the total *amount* by which it was too low would be much greater than the amount by which it was too high. If we want a guess that takes the amount of error into consideration, we will use the mean. The mean score of the fifteen students on verbal comprehension is 13. If we guess each student's verbal comprehension score at 13, the total amount by which this guess is too low will be equal to the total amount by which it is too high.

Central value statistics describing a group are the best guesses we can make about any member of that group. The mode is the guess most often right, the median has an equal chance of being too high or too low, and the mean may be too high by the same total amount as it may be too low.

Measures of Variability

Human beings differ, as do all organisms. They differ in the way they respond to stimuli.

They differ in their ability to learn and to perceive. By studying the variability among persons on various dimensions and relating these findings, the psychologist attempts to describe, understand, predict, and control behavior.

As we have seen, there are several measures of central value for indicating the average level of a group under different circumstances. Similarly, there are several measures of variability for indicating the individual differences within a group.

The range. Perhaps the simplest way to get an idea of how spread out a distribution is, is to find the *range*. The range is the difference between the highest and lowest scores. In the table of verbal comprehension scores, the highest score is 20 and the lowest is 7. Therefore, the range is $20 - 7 = 13$.

Variability statistics, like central value statistics, must be appropriate to the level of measurement used. The range requires *interval* measurement, since subtraction is involved. Without equal units on the scale of measurement, subtraction would be meaningless.

The range is a relatively uninformative measure of variability, since it depends on only two of the scores. Suppose one student had made a score of 3 on the verbal comprehension test. This single score would have increased the range by nearly one third. A variability measure, or any other statistic that uses all of the scores in a distribution, will give more information than one that uses just a few.

The standard deviation. The purpose of a variability statistic is to tell us how spread out a distribution is. Stated another way, it tells us how well or how poorly a central value statistic represents all of the scores in a distribution. If all of the scores are closely bunched together, each score is closely represented by a central value statistic such as the mean. With measurements on the interval scale, the most common measure of variability is the standard deviation. Every score in the distribution is used in its computation. More specifically, it is based upon each score's deviation from the mean. A score's deviation from the mean is denoted by the small letter x . Mathematically it may be expressed by the formula:

$$x = X - \bar{X}$$

which means the deviation is equal to the score minus the mean.

At first thought, it might seem that a good way to measure variability, using all the scores, would be simply to average all these deviations. To do so, however, would prove disappointing. Remember, the deviation of a score is equal to that score minus the mean. If a score is above the mean it will have a positive deviation. If it is below the mean it will have a negative deviation. We have seen that the total amount by which the mean is too low (the positive deviation) is equal to the amount by which the mean is too high (the negative deviation). Thus if all the plus and minus deviations are added together, they cancel out, and the result is zero. Mathematically,

$$\Sigma x = 0$$

This will be true of any group of scores. To avoid this, each deviation can be squared (multiplied by itself) before adding.¹ Since a positive number multiplied by a positive number results in a positive number, and a negative number multiplied by a negative number also results in a positive number, all squared deviations must be positive, and the average of these *squared* deviations can easily be obtained:

$$s^2 = \frac{\Sigma x^2}{N}$$

The symbol s^2 is called the *variance*. The above formula is read, "The variance is equal to the sum of the squared deviations divided by the number of cases."

The reason that the variance is shown as the square of a quantity is to reflect the fact that all the deviations were squared before averaging. The variance is therefore expressed in terms of a different unit from the original measurements. If the original measurements were verbal comprehension scores, the variance would be in terms of squared verbal comprehension scores. Since this is at best an unwieldy concept, the square root of the variance is often

1. There are other, more mathematically sophisticated reasons for squaring the deviations, but a discussion of them is beyond the scope of this book.

used as a measure of variability. This is called the *standard deviation*, and its symbol is the letter s . It is computed by the formula:

$$s = \sqrt{\frac{\sum x^2}{N}}$$

The standard deviation, then, is in terms of the same units as the measurements from which it was derived.

The steps used to compute the standard deviation are given in the figure. The verbal comprehension test scores are used for this example.

The mean score is 13, and the standard deviation is 3.8. These two statistics give us a summary of the fifteen scores. The mean gives us a

representative figure for the level of the group as a whole and the standard deviation a representative figure for all the deviations, because it indicates how closely the scores cluster around the mean.

Standard scores. We have seen that measures of variability are a useful means of summarizing the individual differences in a group. They can also serve to establish a standard unit. Suppose that the high-school students who took the verbal comprehension test were also given a spelling test. We might then wonder if a student is as good in verbal comprehension as he is in spelling. Suppose the means on the tests and the scores of one student, John, are as follows:

VARIANCE AND STANDARD DEVIATION

Student	Score on verbal comprehension test	Deviation	Deviation squared
	X	x	x^2
John	20	7	49
Mary	18	5	25
Shirley	18	5	25
Peter	17	4	16
Alice	16	3	9
Nancy	13	0	0
Henry	13	0	0
Diane	12	-1	1
Douglas	11	-2	4
Sam	11	-2	4
Harvey	10	-3	9
Jane	10	-3	9
Barbara	10	-3	9
David	9	-4	16
Roger	7	-6	36
Sum	195	0	212

1. Add all the scores. This sum is called ΣX .

$$\Sigma X = 195$$

2. Divide this sum by the number of scores (N). This is the mean, \bar{X} .

$$\bar{X} = \frac{\Sigma X}{N} = \frac{195}{15} = 13$$

3. Subtract the mean from each score to find each deviation, x .

$$x = X - \bar{X} \text{ (See the column headed "Deviation")}$$

4. Square each deviation. That is, multiply each deviation by itself.

$$x^2 = (X - \bar{X})^2$$

(See the column headed "Deviation squared")

5. Add all the squared deviations. The result is designated as Σx^2 .

$$\Sigma x^2 = 212$$

6. Divide this sum by the number of scores to find the variance, s^2 .

$$s^2 = \frac{\Sigma x^2}{N} = \frac{212}{15} = 14.13$$

7. Find the square root of the variance. This is the standard deviation, s .

$$s = \sqrt{\frac{\Sigma x^2}{N}} = \sqrt{14.13} = 3.8$$

Test	Mean Scores	John's Scores
Verbal comprehension	13	20
Spelling	44	48

We know that John is above average on both tests. But we do not know *how much* above average. We cannot compare his two scores because we do not know whether one point on one test is equivalent to one point on the other test. Chances are that it is not. Suppose that one point on the spelling test is worth 2 points on the verbal comprehension test. This would mean that John's 4 points above the mean on spelling would be equivalent to 8 points above the mean on verbal comprehension. Since John was only 7 points above average on verbal comprehension, we would know that his spelling score was higher. On the other hand, if the units on the two tests are equivalent, he is better in verbal comprehension.

In order to relate the units on one test to the units on the other, we can make use of our measures of variability. We know that the standard deviation of the verbal comprehension scores is 3.8. John's score of 20 is 7 points above the mean, or almost 2 standard deviations above it. Suppose we computed the standard deviation of the distribution of scores on the spelling test, and found it to be equal to 4. This would mean that John was one standard deviation above the mean in spelling, while he was almost two standard deviations above the mean in verbal comprehension. We could then say that John did better in verbal comprehension than in spelling.

The standard deviation, then, can be used as a unit for comparing deviations. Any individual's deviation from the mean can be expressed in terms of this unit. Scores expressed this way are called *standard scores*.

A standard score is given the symbol z . It is the number of standard deviations above or below the mean where a given score falls. John's actual z score is the deviation of his score from the mean $(X - \bar{X})$, divided by the standard deviation:

$$z = \frac{(X - \bar{X})}{s}$$

John's score on the verbal comprehension test is 20. The mean is 13 and the standard deviation

is 3.8. His standard score would therefore be:

$$z_{\text{John}} = \frac{(20 - 13)}{3.8} = 1.8$$

This means that John scored 1.8 standard deviations above the mean. His standard score, then, is 1.8. Notice that if John had made the mean score, 13, his standard score would be 0. If he had scored below the mean, his z score would be a negative number.

An individual's standard scores on two different tests can be compared directly because standard scores are expressed in equivalent units (standard deviations). It should be remembered, however, that what a standard score gives us is a person's position in the group in which he took the test. Therefore, if we compared John's standard score in verbal comprehension with his standard score in spelling, we would be answering the question, "Is John's *relative* performance in spelling better or worse than his *relative* performance in verbal comprehension?"

The computation of the standard deviation requires a measurement scale of equal units. The standard deviation, like the arithmetic mean, may therefore be used only when measurement is at least at the interval scale. Where we want to compare an individual's relative performance on two or more sets of measurements and have only an ordinal scale, a different descriptive statistic, the *partile*, is used.

Partiles. Partiles are the points which divide a distribution of scores into some number of equal parts. We have already discussed one type of partile, the median. The median divides a distribution into two equal parts. Another type of partile is the *quartile*. There are three quartiles to a distribution, dividing it into four equal parts (quarters). Three fourths of the scores are below Q_3 , which is the third quartile. One half of the scores are below Q_2 , which is the second quartile. Since Q_2 divides the scores exactly in half, it is the same as the median. One fourth of the scores are below Q_1 , the first quartile.

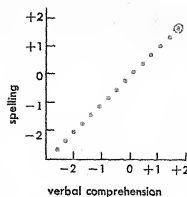
Probably the most common partile used in psychology is the *centile*. There are 99 centiles to a distribution, dividing it into 100 equal parts; 99 per cent of the scores are below the

99th centile, 98 per cent below the 98th centile, and so on. Since one half of the scores are below the 50th centile, it is the same as the median and the second quartile. Scores of an individual on two or more ordinal scales may be compared by converting each of them to the nearest centile.

Measures of Correlation

Up to this point we have been discussing statistics which describe a single set of measurements. Psychology is usually concerned with many different variables, hence with many different sets of measurements. A question frequently asked in psychological research is: to what extent are two sets of scores related? For example, if we gave a verbal comprehension test and a spelling test to the same group of individuals, we might wonder to what extent persons who scored high on one test also scored high on the other. One way to find out would be to write down the names of all the persons scoring above the mean on the verbal comprehension test and see how many of them scored above the mean on the spelling test. This would give us a rough idea of the *correlation* between the two tests. If all the high scorers on one test scored high on the other test too, we would say there was a high *positive correlation*. If all the high scorers on one test scored low on the other test, we would say there was a high *negative correlation*.

Let us now approach an understanding of correlation by building on our knowledge of standard scores (z scores). Suppose that all the scores on the spelling and verbal comprehension tests are converted to standard scores, and assume further that each individual's z score on the spelling test is the same as his z score on the verbal comprehension test. In such a case, the tests are said to have a *perfect positive correlation*. This result is shown in the graph below, in which each dot represents an individual, and the scores of any individual can be read from the horizontal and vertical axes. For example, John (the circled dot) made a z score of 1.8 on both tests. Notice that any individual's score on one test can be predicted exactly if we know his score on the other test.



The amount by which two variables are correlated is expressed in the coefficient of correlation (r). Such coefficients can range from -1 (perfect negative correlation) through 0 (no correlation) to $+1$ (perfect positive correlation). In actual practice perfect correlations, either positive or negative, are rare.

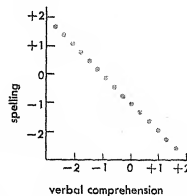
The relation between any individual's z score on one variable (z_x), and his score on the other variable (z_y) is estimated by the equation

$$z_y = r z_x$$

For example, John had a z score of 1.8 on the verbal comprehension test (z_x). If the correlation coefficient is $+1$, his score on the spelling test (z_y) is:

$$z_y = 1 \times 1.8 = 1.8$$

Suppose now that every individual who scored high on verbal comprehension scored low, by an equal amount, on spelling. That is, everyone was as poor on one test as he was good on the other; the best speller was worst on verbal comprehension, and vice versa. A graph of this result follows:



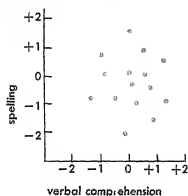
Notice that an individual's score on one test is still exactly predictable if we know his score

on the other, but the sign of the score is reversed. A positive score on one test indicates that the score on the other will be negative by an equal amount. In such a case, the tests are still perfectly correlated, but the correlation is negative. Thus $r = -1$. Using our equation to find John's score on the spelling test gives:

$$z_s = -1 \times 1.8 = -1.8$$

If John's score on verbal comprehension is 1.8, and the tests have a perfect negative correlation, his score on spelling is -1.8 .

In both of these examples, scores on one test were perfectly related to scores on the other. At the other extreme, suppose the scores are completely unrelated. In this case the best speller might be good, average, or poor on verbal comprehension. Knowledge of an individual's spelling ability would tell us nothing about his verbal comprehension. The graph of such a result might look like this:

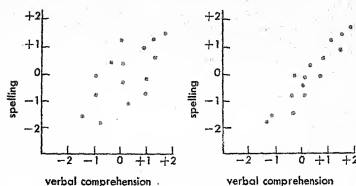


In such a case $r=0$. There is no correlation. If John's z score on verbal comprehension is 1.8, our best guess of his spelling z score would be:

$$z_s = 0 \times 1.8 = 0$$

That is, our best guess would be the mean (0)—the same as our best guess would be if we knew nothing about his verbal comprehension.

Often two variables are correlated, but not perfectly correlated. In a graph of such a relationship, the dots are not in a straight line, nor do they form a circle; their pattern is oval. The flatter the oval—the nearer it is to a straight line—the nearer is the correlation to 1. Compare the following figures with the graphs of 0 and +1 correlation.



Notice that knowledge of performance on one variable gives *some* indication of performance on the other variable. If the correlation between spelling and verbal comprehension is greater than 0 but less than 1, and if John's verbal comprehension score is 1.8, our best estimate of John's spelling score is between 0 and 1.8. The higher the correlation, the closer would be his score to 1.8. Suppose the correlation between the two tests is .70. Substituting in our equation, our best guess of his spelling score is:

$$z_s = .70 \times 1.8 = 1.26$$

We have seen that the best estimate of an individual's standard score on variable x is equal to r times his standard score on variable y . And if the correlation between two variables is +1, z_y will be equal to z_x for every individual.

If z_x is the same as z_y , then multiplying z_x by z_y would be the same as multiplying z_x by itself, or multiplying z_y by itself. Thus,

$$z_x z_y = (z_x)^2 = (z_y)^2 \text{ when } r = 1$$

Furthermore, if we multiply each z_x by the corresponding z_y and average them, the result will be the same as squaring each z_x or z_y and averaging. Symbolically,

$$\frac{\sum z_x z_y}{N} = \frac{\sum (z_x)^2}{N} = \frac{\sum (z_y)^2}{N} \text{ when } r = 1$$

The mean of the squared z scores must equal 1. Remember that the mean of the z scores is 0. The z score, then, is a deviation score, and the mean of the squared z scores is equal to the variance. Since the variance is equal to 1, the

standard deviation is also equal to 1 ($1 = \sqrt{1}$). Therefore,

$$\frac{\sum z_x z_y}{N} = 1 \text{ when } r = 1 \text{ or } \frac{\sum z_x z_y}{N} = r \text{ when } r = 1$$

It can be shown that this value is always equal to r , even when r is not equal to one. In fact, this formula is used to compute r . Stated in its usual form, the formula reads:

$$r = \frac{\sum z_x z_y}{N}$$

Although this discussion may seem rather complex to the beginning student, the actual calculation of the correlation coefficient is simple and straightforward. The steps in computing it, together with an example based on the spelling and verbal comprehension tests discussed earlier, are shown in the figure. •

THE USE OF STATISTICAL INFERENCE

The greatest value of statistical methodology lies in the fact that it allows us to generalize. Psychologists do not usually wish to confine their conclusions to the specific groups which they select for observation or experimentation. Instead, they hope to find relationships which will apply to much larger groups or to human beings in general. This procedure of drawing general conclusions by studying samples is called *statistical inference*. In developing general theories of human behavior it would be impossible to study all human beings under all conditions. The experimental psychologist will, therefore, deduce a specific hypothesis from a theory and design an experiment to test it on a sample. If the results come out as hypothesized, the psychologist has increased his confidence in the validity of the theory. If the results of a carefully designed and executed experiment are contrary to the hypothesis, he has reason to suspect the validity of the theory.

Statistical inference is sometimes used in investigations which are not concerned with theory, but which attempt to find the answer to a specific practical question. This is the area of applied research. A common example of statistical inference in applied research is the public opinion poll. The accuracy of the pollsters in making predictions of group behavior after interviewing only a small sample of the group is

an example of the power of statistical inference techniques.

The basic steps in statistical inference, whether theoretical or applied, are as follows:

1. Define a *population*. The population (sometimes called a *universe*) is the whole group in which the researcher is ultimately interested. It may be as general as all human beings, or even all living organisms. It may be as specific as all freshmen in a certain college or all male registered voters in a certain congressional district.

2. Draw a *sample* from the population. The sample is the group upon which the research is conducted.

3. *Measure* the sample. This is the actual research or experimentation. Depending upon the nature of the research, this measurement might be as simple as asking the subjects whom they are going to vote for in the next election. On the other hand, it might be extremely complex, perhaps including dividing the sample into several experimental groups, exposing each group to different experimental conditions, and measuring their responses to these conditions.

4. Compute one or more *descriptive statistics*. As we have seen, descriptive statistics summarize a series of measurements.

5. Use the descriptive statistics to make *inferences* about the population.

Sampling

Sampling, as you might surmise, is the process of drawing a sample from a population. Whatever sampling procedure is used, it must be one which assures that the sample is truly representative of the population. More specifically, the sample must represent, within known limits, all characteristics of the population which are related to the experimental problem. Otherwise, the sample is called a *biased one*.

There are many methods of sampling, the most common of which is *random sampling*. In random sampling there are two requirements: (1) each member of the population must have the same probability of appearing in the sample; (2) the probability of each member being selected must be independent of whether or not any other member is selected. An example of random sampling is the choosing of the winners in a well-run lottery. All the tickets (the population) are thoroughly mixed, and the

winners (the sample) are selected blindly. Technically, random sampling requires the replacement of each winning ticket before drawing the next, so that it is possible for the same ticket to be drawn more than once. If the population is large, however, this refinement is insignificant. A less cumbersome method of random sampling is to assign consecutive numbers to each member of the population and then select numbers from a table in which all numbers appear in random order. These tables are so constructed that the probability of any number appearing in any position on the list is the same. One such table is published in book form (Rand, 1955). Although such a book does not make very interesting reading, it is of great value to researchers.

Statistics and Parameters

Once a sample is drawn, measurements may be taken and descriptive statistics computed.

CORRELATION

Student	Verbal comprehension		Spelling		$z_x z_y$
	X	$z_x = \frac{X - \bar{X}}{s_x}$	Y	$z_y = \frac{Y - \bar{Y}}{s_y}$	
John	20	1.8	48	.8	1.44
Mary	18	1.3	45	.2	.26
Shirley	18	1.3	45	.2	.26
Peter	17	1.1	37	2.5	2.75
Alice	16	0.8	39	-.9	-.72
Nancy	13	0	42	-.4	0
Henry	13	0	52	1.5	0
Diane	12	-.3	43	-.2	.06
Douglas	11	-.5	47	.6	-.30
Sam	11	-.5	44	0	0
Harvey	10	-.8	41	-.6	.48
Jane	10	-.8	37	-1.3	1.04
Barbara	10	-.8	43	-.2	.16
David	9	-1.1	40	-.8	.88
Roger	7	-1.6	37	-1.3	2.08
					$\Sigma z_x z_y = 8.39$

1. Compute the means and the standard deviations for both of the variables being correlated.

$$\bar{X} = 13 \quad s_x = 3.8$$

(See pp. 558-560)

$$\bar{Y} = 44 \quad s_y = 5.3$$

(Obtained in the same manner as \bar{X})

2. Convert each score to a standard score by subtracting its mean and dividing by its standard deviation.

(See columns headed z_x and z_y)

3. Multiply the two standard scores together for each individual in the group.

(See the column headed $z_x z_y$)

4. Find the arithmetic mean of these products by adding them together and dividing by the number of individuals.

$$r = \frac{\Sigma z_x z_y}{N}$$

$$= \frac{8.39}{15}$$

$$= .56$$

Such statistics may then serve as estimates of their counterparts in the population as a whole. These counterparts are called *parameters*. Different symbols are used to distinguish between statistics and parameters: Arabic letters are conventionally used for statistics and Greek letters for parameters. We have seen that the symbols for sample mean, standard deviation, and variance are \bar{X} , s and s^2 , respectively. The symbols used for population mean, standard deviation, and variance are the lower-case Greek letters μ (μ), σ (σ), and σ^2 (σ^2). The two sets of symbols are summarized in the table below:

	Statistic (sample)	Parameter (population)
Mean	\bar{X}	μ
Standard deviation	s	σ
Variance	s^2	σ^2

The most direct way to find a parameter would be to measure every member of the population and compute it. The mean and variance, for example, would be computed by the formulas:

$$\mu = \frac{\sum X}{N} \quad \sigma^2 = \frac{\sum (X - \mu)^2}{N}$$

where X stands for each measurement in the population taken in turn, and N stands for the number of members of the population.

These formulas would give us the exact values of the parameters. However, to measure all members of a population in which we are interested is difficult at best and is often impossible. Instead, we can draw a random sample and know that each member of the population is equally likely to be chosen. We can, therefore, use the measurements from the sample in place of the measurements from the entire population to estimate the parameters. We can estimate the sample mean by the formula:

$$\bar{\mu} = \frac{\sum X}{N} = \bar{X}$$

Here, X and N refer to the sample. The caret over μ shows that this is an estimated, not a computed, value.

The formula shows that the population mean is being estimated by the sample mean. Such an estimate will probably not be equal exactly to the population mean, but it will be close. In addition, it will be too high as often as it will be too low. It is, therefore, called an *unbiased estimate*.

To estimate the population variance, we again substitute sample measurements for population measurements. One formula for estimating the population variance is:

$$\hat{\sigma}^2 = \frac{\sum (X - \mu)^2}{N}$$

If we knew the value of the population mean, μ , we could substitute it and each sample measurement taken in turn into this formula and have an unbiased estimate of the population variance. Normally, however, we do not know the exact value of the population mean. We therefore use the sample mean in its place. In doing this, however, we introduce a bias. The sum of the squared deviations from the mean of a sample is less than the sum of the squared deviations from any other value. Therefore, if the sample mean is not exactly equal to the population mean, our estimate of the population variance will be too small. To remove this bias, a slight correction is made. The formula used for estimating the population variance is then as follows:

$$\hat{\sigma}^2 = \frac{\sum (X - \bar{X})^2}{N - 1}$$

This formula contains an important new concept. If we compare this formula with the formula for the variance of a sample, we find that the only difference is that here $N - 1$ is used in the denominator instead of N . If N is large, this difference is unimportant as far as computation is concerned. It is very important, however, in terms of its meaning. The term $N - 1$ is called *degrees of freedom*, or *df*.

Suppose we draw a sample of two members, and compute its mean as an estimate of μ . If we then compute the sum of the squared deviations, upon how many measurements is it based? The answer is one, not two. Before we compute the mean, the two members in our sample can conceivably have any two values. The value of one does not affect the value of

the other. Both are "free to vary." There are two degrees of freedom. But after we compute the mean, only one value is free to vary. For example, if the mean is 10, and the value of one member is 8, the value of the other member *must* be 12. This is because establishing the mean uses up one degree of freedom. This is true for any size sample.

The best estimate of a parameter will contain a certain margin of error. It is important to know just how great this error is. Such knowledge is obtained by means of a mathematical model. A model is an abstraction which is used to describe real world phenomena. The model most often used by psychologists in this case is called the *normal distribution*.

The Normal Distribution

A very typical finding in psychological research is that most individuals cluster near the mean of a distribution of scores. The farther from the mean a given score is, the fewer individuals will have that score. Suppose we selected 100 persons at random from the population of the United States and administered an IQ test to them. We would get results some-

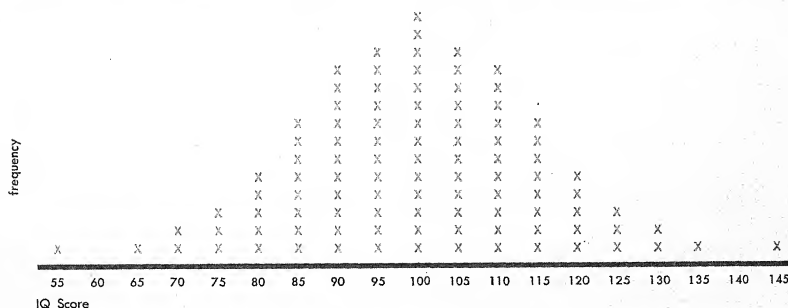
thing like those plotted in the figure. [▲]

This method of presenting data is called a *frequency distribution*. It shows the frequency with which each measurement value appears in a sample. The numbers along the base line represent IQ's. Each X represents a person, and is placed above the figure indicating his IQ. For simplicity, the IQ's are rounded off to the nearest 5 points.

We can identify three properties of this distribution of scores. (1) the number of persons with a given score diminishes as the distance of that score from the mean increases; (2) the distribution is symmetrical about the mean; (3) the mode, the median, and the mean are equal.

This frequency distribution can be approximated by a *bell-shaped curve* that encloses all the X's in the frequency distribution. Because frequency distributions of psychological measurements are so often closely approximated by the bell-shaped curve, it is convenient to take this curve as a model, or ideal case. This model, the *normal distribution*, is a generalization about frequency distributions, just as "50-50," for example, is a generalization about the odds in tossing coins. If a number of coins are tossed, the "model" expectation is that half will turn up heads. This is seldom exactly true, but as

▲ THE NORMAL DISTRIBUTION



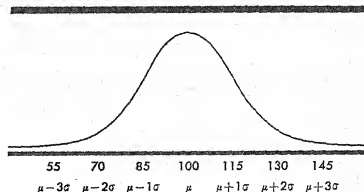
more coins are tossed, the model is more closely approximated. The same thing is true also for the normal distribution: a perfect normal curve is never obtained from a sample of measurements, although the larger the sample, the more closely it will approximate the normal curve. An infinitely large population would be required to fit perfectly the mathematical definition of the curve. When obtained measurements closely approximate the normal curve, the assumption is often made that the sample has been drawn from an infinitely large population that does fit the model exactly.

This assumption is often helpful, because the normal distribution is an extremely useful model. It allows us to describe a population distribution exactly by substituting two parameters, the mean and standard deviation, into its mathematical equation. Thus if a distribution is normal, and its mean and standard deviation are known, we may describe it in every detail. For example, the Wechsler Adult Intelligence Scale (see p. 155) was administered to a carefully selected sample. The estimated population mean was 100, the estimated population standard deviation was 15. These two parameters, plus the assumption that intelligence is normally distributed in the population, made it possible to construct a curve showing the distribution of IQ's in the whole population. ♦

As in the distribution of the sample of scores given earlier, the horizontal axis represents IQ's. In the sample frequency distribution, the vertical axis represented the frequency with which each IQ value was present in the sample. Here, the vertical axis represents the *proportion* of the population having each IQ value. This proportion is greatest at the mean and approaches zero at the two extremes.

There are two important differences between this true normal distribution and the quasi-normal distribution of the sample of scores on page 629. The first is that the distribution is continuous. In the sample, scores were rounded off to the nearest 5 points. That is, the data were presented in discrete steps. Even if each whole number (100, 101, 102, etc.) had been used in giving the IQ's, there would still have been no values between 100 and 101, between 101 and 102, and so on. In the true normal distribution, all intermediary values are possible.

◆ DISTRIBUTION OF IQ'S IN THE POPULATION



The second important difference between a true normal distribution and the distribution of a sample is that the normal distribution extends infinitely in both directions. Although the probability of extreme scores is low, there is theoretically no upper or lower limit. The curve never reaches the horizontal axis, but merely comes increasingly closer to it.

Approximately 68 per cent of the scores are within one standard deviation from the mean. Thus in the above case, about 68 per cent of the area under the curve is between IQ values of 85 and 115, since the standard deviation is equal to 15.

In a normal distribution approximately 27 per cent of the scores are between one and two standard deviations from the mean. In the above example, about 13.5 per cent of the area is between 70 and 85, and about 13.5 per cent is between 115 and 130.¹

Less than 3/10 of 1 per cent of the scores are farther than three standard deviations from the mean. For this reason, the range of six standard deviations—three below the mean and three above it—is taken as representing the “practical” limits of a normal distribution. Unless a sample is extremely large, we will seldom find scores which exceed these limits.

Up to now we have been discussing the distributions of scores or other measurements. The mathematical model known as the normal distribution has another application which is

1. These figures are approximate. Exactly 95 per cent of the cases fall within not 2 but 1.96 standard deviations of the mean. This figure becomes important in null hypothesis testing (p. 632).

perhaps even more useful in statistical inference. This application tells us how much error we make in estimating a parameter from a statistic. To do this, we make use of a different type of distribution known as a *sampling distribution*.

Sampling Distributions

Suppose we take a sample of 50 persons and measure their IQ's. If the mean of the whole population is 100, the mean of this sample will probably be very close to 100. Chances are, however, that it will not be exactly 100. It will probably deviate from 100 by a point or two. If we took another sample of 50 and computed its mean, we would again get a value near 100 but probably not exactly equal to it. If we continued this process of drawing samples and computing mean IQ's, we could build up a distribution of means, each mean being based on a sample of 50 scores. Such a distribution is called a *sampling distribution*. A sampling distribution is a distribution of statistics, each based upon a sample. In this case it is a sampling distribution of means. The mean of such a sampling distribution of means would be extremely close to the population mean. Its standard deviation would be very small, since each element of the distribution is the mean of 50 scores, and therefore is itself a good estimate of the population mean.

We have discussed three types of distributions: the frequency distribution, the population distribution, and the sampling distribution. The first two of these distributions are somewhat similar. They are made up of individual measurements or scores. The difference is that the frequency distribution is based upon measurements that we actually have at hand, that is, the measurements actually taken on our sample. The population distribution is something we do not have at hand, but must conceptualize. It is the distribution of all the scores in a particular population. In order that we may use the powerful model of the normal distribution, we assume that the population is of infinite size.

A sampling distribution is a distribution of statistics, rather than individual measurements.

For example, the sampling distribution of means is based upon a series of means, each computed on a random sample of a particular population. The samples are all of the same size. We can mathematically determine the form of a sampling distribution which is based upon an *infinite* number of sample means. The form of the sampling distribution of means will be normal if the original population of measurements forms a normal distribution. Even if the population is not normal, the sampling distribution of means will be normal if the means are based upon samples that are "large enough." How large they must be depends upon the form of the population distribution.

The mean of the sampling distribution (that is, the mean of the sample means) will be equal to the population mean. The standard deviation of the sampling distribution of means is called the *standard error of the mean*. It is determined as follows:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{N}}$$

The standard error of the mean tells us how closely any particular sample mean represents the population mean. Just as approximately 68 per cent of the scores in a normal population distribution are within one standard deviation of the population mean, approximately 68 per cent of the means in a sampling distribution of means are within one standard *error* of the population mean. Similarly, approximately 95 per cent of the sample means are within two standard errors of the population mean.

In the usual research situation, we are not dealing with a population or with a sampling distribution. We are dealing with one sample drawn from a population. By using our knowledge of the form of a sampling distribution, we are able to state how close we expect our sample mean to be to the mean of the population. Because we know that approximately 95 per cent of any sample means will be within two standard errors of the population mean, we can say that our sample is *probably* within two standard errors of the population mean. The word "probably" is used because this statement will be true only about 95 per cent of the time.

However, we usually do not know the value of $\sigma_{\bar{x}}$, so we estimate it from s , the sample

standard deviation. We can combine the formula for estimating σ from s , and the formula for computing $\sigma_{\bar{x}}$ from σ .

$$\hat{\sigma} = s \sqrt{\frac{N}{N-1}} \quad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{N}}$$

Therefore,

$$\hat{\sigma}_{\bar{x}} = \frac{s \sqrt{\frac{N}{N-1}}}{\sqrt{N}} = \frac{s}{\sqrt{N-1}}$$

The caret over $\sigma_{\bar{x}}$ is a reminder that we have not computed the standard error of the mean exactly, but have estimated it from the standard deviation of a sample.

If the standard deviation of a sample of IQ's is 15 and the sample is based on 50 scores, the standard error of the mean is

$$\frac{15}{\sqrt{50-1}} = \frac{15}{7} = 2.14$$

If we computed the standard deviation of a sampling distribution of means, each mean being based on 50 scores, we would find it to be approximately 2.14.

The standard error of the mean is used in two distinct types of statistical inference, *null hypothesis testing* and *establishing confidence intervals*.

Null Hypothesis Testing

Suppose a researcher wants to know whether high-school students are of the same intelligence as people in general. He could give an IQ test to every high-school student and find the mean. This would be a population mean, since everyone in the population in question was tested. An easier way to answer the question is to test only a sample of the high-school population and use statistical inference.

Let us say that the researcher tests a random sample of 50 and finds a mean of 105 and a standard deviation of 15. The mean of his sample is above the average IQ of 100, but he cannot conclude yet that high-school students as a whole have a higher mean IQ than people in general. After all, he has tested only 50 out of a

population of several million students. It is possible that he just happened to get brighter students in his sample.

His first step is to assume that nothing but the laws of chance are operating in producing a sample mean different from 100. This assumption is called the *null hypothesis*. The exact statement of the null hypothesis in this case is: "The population of high-school students from which this sample was randomly selected does not differ from people in general and thus has a mean of 100."

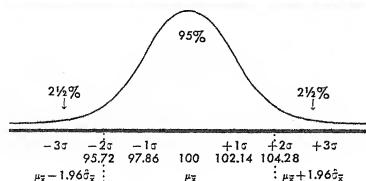
The next step is to establish a criterion for *rejecting* this hypothesis. As long as he tests only samples, he cannot eliminate chance entirely and must decide what degree of certainty he will insist on. It is traditional to set the criterion at what is called the 5 per cent level. If he chooses this criterion, he will reject the null hypothesis only if the probability of being wrong by doing so is less than 5 in 100 and, correspondingly, there is at least a 95 per cent chance of his being right.

As we have seen, the standard error of a mean of 50 scores whose standard deviation is 15 is 2.14. His sample mean is equal to $\frac{105-100}{2.14} = 2.34$ standard errors from 100. This is called the *critical ratio*. By consulting a table based on the normal curve, he finds that the probability of obtaining a critical ratio as large as 2.34 is less than 5 in 100. This means that the difference between his obtained sample mean and the null hypothesis population mean of 100 is so great that it could happen by chance alone less than five times in one hundred samples. Such a difference is said to be *statistically significant*, and he can reject the null hypothesis. He is safe in inferring that the mean of his population is *not* 100, and therefore that the mean of high-school students' IQ's is different from the mean IQ of people in general.

To visualize how he could assess the probability of the 5-point discrepancy he found between his sample mean and the mean of people in general, consult the sampling distribution of means. Its mean is equal to the population mean. Its standard deviation is equal to the standard error of the mean. The shaded areas represent the extreme 5 per cent of the area under the curve—half at each end. This 5 per cent

CRITICAL REGIONS IN TWO-TAILED TEST

We know that 95 per cent of the cases fall within 1.96 standard deviations above and below the mean. Since the population mean (μ_x) is 100 and the estimated standard deviation of this distribution of means ($\hat{\sigma}_x$) is 2.14, we find that $\mu_x + 1.96 \hat{\sigma}_x$ is $100 + 1.96 \times 2.14$, or 104.19. Our obtained mean, 105, is above this point, which places it in the critical region.



of the area is called the *critical region*. If the null hypothesis is true—that is, if the population mean is actually 100, the probability that a sample mean will fall into the critical region is less than 5 per cent. Since 105, the obtained mean IQ of the sample of high-school students, falls into the critical region, we reject the null hypothesis.

Notice that we would also reject the null hypothesis if the sample mean had fallen into the shaded area on the left (lower) tail of the distribution. Remember, our null hypothesis is that the population mean is 100. We will therefore reject this hypothesis when our obtained sample mean is extremely high or extremely low. Since both tails of the sampling distribution are involved in testing the null hypothesis, this is called a *two-tailed test*.

We might have asked if high-school students in general were of superior intelligence. For this question also, the null hypothesis would be that high-school students are of average intelligence. Stated precisely, the null hypothesis is, as before, that “the population from which this sample was randomly selected has a mean of 100.” Again we have a sampling distribution of means with a mean of 100 and a standard deviation (estimated standard error) of 2.14. This time, however, the critical region is entirely on

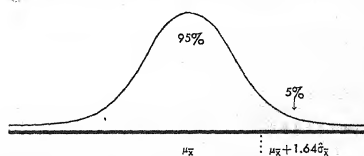
the right (upper) tail of the sampling distribution. It represents the *upper* 5 per cent of the area under the curve, instead of 2½ per cent at each end. Since only one tail of the sampling distribution is involved, this is called a *one-tailed test*.

In the above discussion, inference is made from one sample mean. Another inference frequently made in psychological research is from the difference between two sample means, after the samples have undergone different experimental treatments.

For example, a psychologist wonders whether ego-involvement affects performance on a simple psychomotor task. The task he selects is transferring pegs from one end of a pegboard to the other. He uses 100 aviation cadets as subjects, randomly assigning fifty of them to an experimental group and fifty to a control group. He tells the experimental group that this task is actually a valid predictor of ability to learn to pilot a high performance aircraft or a space ship. The control group is told that this is a test of suitability for routine assembly work in a factory. The experimenter assumes that the experimental group is more ego-involved than the control group. The independent variable, therefore, is ego-involvement versus no ego-involvement. The dependent variable is the number of pegs transferred in thirty seconds. The experimental hypothesis is that the performance of the experimental group will be significantly different from that of the control group. The null hypothesis is that any obtained difference in means will be due to chance alone.

The descriptive statistic for the obtained difference in means is $\bar{X}_e - \bar{X}_c$, where \bar{X}_e is the mean number of pegs transferred in thirty

CRITICAL REGIONS IN ONE-TAILED TEST



seconds by the experimental group and \bar{X}_c is the mean for the control group. Under the null hypothesis, the sampling distribution of $\bar{X}_e - \bar{X}_c$ would have a mean of zero. That is,

$$\mu_{\bar{X}_e - \bar{X}_c} = 0$$

under the null hypothesis. The standard deviation of this sampling distribution is the *standard error of a difference between two means*. To test the null hypothesis, we must estimate this standard error. This can be done by the formula,

$$\hat{\sigma}_{\bar{X}_e - \bar{X}_c} = \sqrt{(\hat{\sigma}_{\bar{X}_e})^2 + (\hat{\sigma}_{\bar{X}_c})^2}$$

We already have seen how to compute the standard error terms under the square root sign. By inserting them into the above formula, we can estimate the standard error of a difference between two means.

In order to see how the various computations are made, look at the figures for this hypothetical experiment, which are worked out below.

Group:	N	\bar{X}	s
Experimental	50	72	21.0
Control	50	62	24.5

Null Hypothesis: The difference between means is due entirely to chance. It arises from sampling a population distribution which has a mean of zero.

Significance level required to reject null hypothesis: 5%

Critical ratio required to reject null hypothesis at 5% level: 1.96

Estimated standard error of experimental group mean:

$$\hat{\sigma}_{\bar{X}_e} = \frac{s_e}{\sqrt{N-1}} = \frac{21.0}{\sqrt{49}} = 3.0$$

Estimated standard error of control group mean:

$$\hat{\sigma}_{\bar{X}_c} = \frac{s_c}{\sqrt{N-1}} = \frac{24.5}{\sqrt{49}} = 3.5$$

Estimated standard error of the difference between means:

$$\hat{\sigma}_{\bar{X}_e - \bar{X}_c} = \sqrt{(\hat{\sigma}_{\bar{X}_e})^2 + (\hat{\sigma}_{\bar{X}_c})^2} = \sqrt{(3.0)^2 + (3.5)^2} = 4.61$$

Obtained difference between means:

$$\bar{X}_e - \bar{X}_c = 72 - 62 = 10$$

Difference between means under null hypothesis: 0.

Critical ratio: Obtained difference minus difference under null hypothesis divided by standard error $= \frac{10-0}{4.61} = 2.17$

Since the obtained critical ratio (2.17) is greater than the critical ratio required for rejecting the null hypothesis (1.96), the null hypothesis is rejected. We say that the obtained difference between means is significant at the 5 per cent level. We can therefore infer that ego involvement, as operationally defined in this experiment, affects performance on this task.

Before we leave the subject of null hypothesis testing, let us consider one refinement. The critical ratio is obtained by dividing the standard error into the difference between the means. If the estimate of the standard error were exactly correct, the significance test would be exact. When the sample is reasonably large, the estimated standard error will be close enough to the exact standard error that any possible discrepancy may be ignored. If the sample is small, however, this possible discrepancy should be considered. This is done by using a *t ratio*, which is similar to a critical ratio but takes into account the size of the sample. The *t ratio* required for rejecting a null hypothesis at a specified significance level is slightly greater than the critical ratio. The larger the sample, the closer the two will be. In the hypothetical experiment described above, the *t ratio* required for significance at the 5 per cent level is 1.98, which is slightly greater than the critical ratio of 1.96.

Confidence Intervals

Instead of merely accepting or rejecting a null hypothesis about a parameter, an experimenter often wishes to make a quantitative estimate of its value. As we have already seen, a parameter can be estimated from a statistic. The precision of such an estimate depends upon the size of the sample—the larger the sample, the more precise the estimate.

To be of value, an estimate of a parameter should include some indication of its precision. Accordingly, the experimenter may state one value which is probably less than the parameter and another value which is probably greater than the parameter. These two values form the *confidence interval* that probably includes the parameter. The word "probably" is defined in terms of a percentage. Thus, the 95 per cent confidence interval is the interval of scores which has 95 chances out of 100 of including the parameter. The following hypothetical study illustrates the use of confidence intervals.

A psychologist engaged in consumer research wants to know how much the average family in his city spends on clothing in one year. Since it is not feasible to interview every family in the city, he decides to interview a random sample of families and generalize from the sample to the population. The population in this case consists of every family in the city. For the sake of illustration, we will assume that the psychologist has a city directory which lists every family. Using a table of random numbers, he selects 500 families for his sample. He sends an interviewer to each family to determine how much they spend in one year on clothing. This is a difficult measurement problem, since many respondents are unwilling or unable to estimate such costs. However, by using highly trained interviewers and a carefully planned checklist, the psychologist is satisfied that the measurements made are reasonably accurate. After all the data are obtained, he computes the mean and the standard deviation, as follows:

$$\begin{aligned}\bar{X} &= \$521.60 \\ s &= \$152.48\end{aligned}$$

His next step is to generalize from the sample to the population. He wants to know the average amount spent for clothing by all families in the city. He decides to establish the 95 per cent confidence interval for this population mean. To find this interval he must first estimate the standard error of the mean:

$$\hat{\sigma}_{\bar{x}} = \frac{s}{\sqrt{N-1}} = \frac{\$152.48}{\sqrt{500-1}} = \$6.83$$

Just what does this value mean? Suppose the psychologist continued drawing random samples of 500 families from the same population

and repeated the above process for each sample. The sample means would form a normal sampling distribution. The standard deviation of this distribution of means would be equal to the standard error of the mean, which is estimated to be \$6.83. Since 95 per cent of the area under a normal distribution curve is within 1.96 standard deviations from the mean, 95 per cent of the sample means would be within 1.96 standard errors of the population mean. That is, 95 per cent of the sample means he obtains would be within \$13.39 ($= 1.96 \times \6.83) of the true population mean. Therefore, if the psychologist states that the population mean is not more than \$13.39 above or below \$521.60 (the mean of the sample which he actually measured), he has 95 chances out of 100 of being correct. The 95 per cent confidence interval is therefore from \$508.21 to \$534.99. The psychologist can state with 95 per cent confidence that the average family clothing expenditure in his city is between \$508.21 and \$534.99.

The use of 95 per cent in the above example was purely arbitrary. He could just as well have used 90 per cent or 99 per cent, depending upon the risk of being wrong that he was willing to take. If he had used 90 per cent, the confidence interval would have been smaller. With 99 per cent, the confidence interval would be larger.

Analysis of Variance

In assessing the results of a study performed with randomly selected groups, the experimenter finds himself faced with the problem of determining whether differences between experimental groups are in fact the result of the factor he set out to study, or whether they are due to random variation between groups of subjects. The technique by which he can do this is called *analysis of variance*.

Suppose the experimenter is interested in determining whether diet has an effect upon the ability to memorize. He decides to study the effect of five different diets upon memorizing performance. A sample of fifteen subjects is obtained and, using a table of random numbers, the experimenter randomly assigns three subjects to each of five experimental groups. Because this assignment is made randomly, he

knows that each experimental group is a sample of the same population. He doesn't know exactly what population, but feels that the sample is reasonably representative of the group to which he wishes to make an inference concerning the effect of diet.

He then assigns a different diet to each experimental group. Sample A is given one diet; Sample B is given another diet; and so on. Diet is the independent variable. At the end of the experimental period the experimenter measures how many trials it takes each subject to memorize a list of nonsense syllables. This measurement is the dependent variable. The scores of the fifteen subjects, grouped by sample, and the means of the samples, are as follows:

Sample	Individual Scores in Sample	Sample Mean
A	10, 12, 14	12
B	8, 10, 12	10
C	12, 16, 17	15
D	15, 16, 17	16
E	10, 13, 13	12

Did the different diets make a difference? It looks as if the diet of Group B might improve memorizing performance. The three subjects having this diet required only 10 trials, on the average, to learn the list. This is quite a bit better than the three subjects in Group D, who averaged 16 trials. While it is true that Group B did better than Group D, the experimenter does not yet know if this is due to the different experimental treatments. It might be due to other variables.

All variables, aside from the independent variable, that affect the dependent variable are called *relevant variables*. If relevant variables had been without effect in the experiment, the only cause of variation would be differences in the independent variable. Then all three subjects in Group A would have the same score on the dependent variable, because their diet was the same. All subjects in Group B would have the same score, and so on. There would be no variance within samples. Since there is variance within samples, relevant variables were causing some of the variation.

Many relevant variables can be held constant in an experiment. In the present one, we may

suppose the experimenter tested each subject under reasonably standard conditions of temperature, light, freedom from distractions, and so forth. There are, however, several relevant variables he could not hold constant. These are the subject variables. Some subjects may have been better at memorizing than others. Some might have tried harder during the experiment. That is to say, there are individual differences in such subject characteristics as ability and motivation. The experimenter was not able to control these relevant variables by holding them constant, so he controlled them by randomization—that is, by randomly assigning subjects to experimental groups. As long as the relevant variation is random with respect to the independent variable (that is, is randomly distributed among experimental groups), the effect of the independent variable can be assessed.

The statistical question to be answered now is whether or not the differences among the sample means are due to this random variation or to the effects of the independent variable. Analysis of variance allows the experimenter to determine how much of the variance in the dependent variable (trials taken to memorize the list) is due to random variation and how much may be attributed to the effects of the independent variable (diet).

The first step is to find an estimate of the population variance that is based only upon random effects. We have seen that all subjects within a sample, would have the same score if only the independent variable were having an effect. Therefore, any variation *within* a sample is due to relevant variables, whose effects should be random because the subjects have been randomly assigned to samples. By pooling together the variance within all samples, then, an estimate of the population variance due to random effects can be obtained. Because it is based on variance within samples, this measure of variation is called the *within variance*.

The within variance is computed in a manner similar to the way the variance of a single sample is computed. The mean of each sample is found. The deviation of each score from the mean of its sample is found. Each deviation score thus represents a deviation within a given sample. The deviation scores are then squared, summed, and divided by the number of degrees

WITHIN VARIANCE

Sample	Score	Sample Mean	Deviation from Sample Mean	Squared Deviation from Sample Mean
		\bar{X}	$(X - \bar{X})$	$(X - \bar{X})^2$
A	10	12	-2	4
	12	12	0	0
	14	12	2	4
B	8	10	-2	4
	10	10	0	0
	12	10	2	4
C	12	15	-3	9
	16	15	1	1
	17	15	2	4
D	15	16	-1	1
	16	16	0	0
	17	16	1	1
E	10	12	-2	4
	13	12	1	1
	13	12	1	1
Sum	195	65	0	38

1. Compute the mean of each sample by adding together the three scores and dividing by three.
(See column headed "Sample Mean")

2. Subtract the sample mean from each score to find the deviation from the sample mean.
(See column headed "Deviation from Sample Mean")

3. Square each of these deviations.
(See column headed "Squared Deviation from Sample Mean")

4. Add all of these squared deviations:

$$\Sigma(X - \bar{X})^2 = 38$$

5. Divide this sum by the number of degrees of freedom ($N - k$) to find the estimate of population variance within samples (this is the within variance.)

$$\begin{aligned}\hat{\sigma}^2 &= \frac{\Sigma(X - \bar{X})^2}{N - k} \\ &= \frac{38}{15 - 5} \\ &= 3.8\end{aligned}$$

of freedom. These steps are the same as those used earlier (p. 628) to estimate population variance from a single sample, but the number of degrees of freedom is different. We saw that establishing the mean of a sample uses up one degree of freedom, so that the number of degrees of freedom is $N - 1$ in the single-sample case. In the present case, the mean has been computed for each sample, and one degree of freedom has been lost for each mean computed. So if the number of samples, and hence the number of means, is k , the number of degrees of freedom left is $N - k$.

The formula for estimating the within variance is:

$$\hat{\sigma}^2 = \frac{\Sigma(X - \bar{X})^2}{N - k}$$

The formula for estimating the population variance from a single sample was merely a special case of this formula. When a single sample is used, $k = 1$, so $N - k = N - 1$. In both cases, deviation scores are obtained by subtracting the sample mean from each score in the sample. When there is only one sample, the mean is always the same; when there is more than one sample, the sample mean used to find a particular deviation score is the mean of the sample from which the particular score came. The computation of within variance for the memory experiment is worked out in the figure. ^A

The within variance gives an estimate of the population variance due only to the random effects of relevant variables. The next step is to find some estimate of the population variance

that includes the effect of the independent variable. If diet has an effect on memorizing, the means of the samples should differ from one another. We have already noticed that Group B did better than Group D, and have realized that this difference could be due both to the independent variable (diet) and relevant variables. We do not know to what extent the differences between samples are due to the independent variable, but it is clear that if the independent variable does have an effect on memorizing, it will cause differences between the samples. The variability between samples, then, is due both to the random effects of relevant variables and to the effect, if any, of the independent variable. The variability between samples is called the *between variance*.

The between variance, like the within variance, is an estimate of the population variance. Unlike the within variance, it is based on a sampling distribution of means, and for this reason it measures the variation due to the independent variable as well as that due to random effects. Each of the five samples in the memory experiment was drawn from the same population. The mean of the distribution of these sample means is an estimate of the population mean. The variance of the distribution of sample means is an estimate of the variance of the sampling distribution of means, $\hat{\sigma}_x^2$. The estimated variance of the sampling distribution can be used to estimate the population variance, as we shall see below. First it is necessary to estimate the variance of the distribution of sample means.

The formula for estimating the variance of a sampling distribution of means is given below:

$$\hat{\sigma}_x^2 = \frac{\sum (\bar{X} - \bar{X}_{\bar{X}})^2}{k-1}$$

The formula is analogous to the previous formulas for variance. Each mean in the distribution of sample means is treated as if it were a score. The mean of the sample means ($\bar{X}_{\bar{X}}$) is calculated, and the deviation of each sample mean from the grand mean (the mean of the sample mean) is found by subtraction. The deviation scores are squared, summed, and divided by the number of degrees of freedom. Because the mean of each sample is treated as a score, the number of degrees of freedom is equal

to the number of means, k , minus 1 for the degree of freedom that was used up in computing the mean of the means.

There is one more step in estimating the variance of the original population. We know the relationship between the standard error of the mean (the standard deviation of the sampling distribution of means) and the population standard deviation to be:

$$\sigma_x = \frac{\sigma}{\sqrt{n}}$$

In analysis of variance, the number of cases in a sample is usually denoted by a small n . The large N stands for the number of cases in all of the samples combined. Thus in the memory experiment, $n=3$ and $N=15$.

If we square both sides of this equation, multiply through by n , and transpose terms, we get:

$$\sigma^2 = n\sigma_x^2$$

We could use this formula to compute exactly the variance of the population if we knew exactly the variance of the sampling distribution. However, since we are only able to estimate the variance of the sampling distribution, we can only estimate the variance of the population. As indicated below:

$$\hat{\sigma}^2 = n\hat{\sigma}_x^2$$

The formulas for the two steps involved in computing this estimate of the population variance, the between variance, can be combined into one formula:

$$\hat{\sigma}^2 = \frac{n\sum (\bar{X} - \bar{X}_{\bar{X}})^2}{k-1}$$

The steps involved in this computation are shown in the figure, using the memory experiment scores as an example. You will find the computations easier to understand if you compare them with the computations in the figure on page 622, where the variance and standard deviation of a sample are worked out. Note that the basic elements used in the present computation are the sample means, *not* the individual scores.

We now have two estimates of the popula-

tion variance. As we have seen, one—the within variance—is an estimate of the variance due to random effects of relevant variables, and the other—the between variance—includes both this variance and the variance due to manipulation of the independent variable. If they are approximately the same, we can assume that the change in the independent variable had no effect, whereas if the between variance is considerably higher, we will suspect that there was indeed an effect from the experimental manipulation—in this case that the difference in diet did have an effect on memorizing.

Checking our computations, we find that the between variance was 18, as compared with only 3.8 for the within variance. Is this a large enough discrepancy for us to reject the null hypothesis—the hypothesis that there is no difference?

To assess the validity of the null hypothesis, we compute what is known as an *F ratio*, which is the ratio of the between sample variance to the within sample variance. The table below summarizes the steps in making this computation.

Source of Variance	Sum of Squared Deviations	Degrees of Freedom	Estimate of Population Variance
Between Samples	72	4	18
Within Samples	38	10	3.8
$F = \frac{18}{3.8} = 4.74$			

The *F* ratio is the ratio of the two estimates of the population variance. The numerator of the *F* ratio is due to random (error) variance plus variance due to the independent variable. The denominator is due to error variance alone. This can be summarized as follows:

$$F = \frac{\text{error variance} + \text{variance due to independent variable}}{\text{error variance}}$$

If the independent variable has no effect, the numerator—like the denominator—will be due

BETWEEN VARIANCE

Sample	Individual Scores In Sample	Sample Mean	Deviation from Grand Mean	Squared Deviation from Grand Mean
	X	\bar{X}	$X - \bar{X}$	$(X - \bar{X})^2$
A	10, 12, 14	12	-1	1
B	8, 10, 12	10	-3	9
C	12, 16, 17	15	2	4
D	15, 16, 17	16	3	9
E	10, 13, 13	12	-1	1
Sum	195	65	0	24

1. Compute the mean of the sample means. This is done by adding up all the sample means and dividing by k , the number of samples:

$$\bar{X}_{\bar{X}} = \frac{\Sigma \bar{X}}{k} = \frac{12+10+15+16+12}{5} = 13$$

2. Subtract the grand mean from each sample mean, to find the deviation of the sample mean. (See the column headed "Deviation from Grand Mean")
3. Square each of these deviations. That is, multiply each deviation by itself. (See the column headed "Squared Deviation from Grand Mean")

4. Add all the squared deviations:

$$\Sigma(X - \bar{X}_{\bar{X}})^2 = 1+9+4+9+1 = 24$$

5. Multiply this sum by n , the sample size:

$$24 \times n = 24 \times 3 = 72$$

6. Divide this by the number of degrees of freedom ($k-1$, where k is the number of samples) to find the estimated population variance:

$$\hat{\sigma}^2 = \frac{n \Sigma(X - \bar{X}_{\bar{X}})^2}{k-1} = \frac{72}{5-1} = 18$$

entirely to error variance, and the ratio will be 1. In our case, however, the figure is 4.74. Our next step is to find out how likely it is that an F ratio this large would happen by chance even though the independent variable had no effect—what would happen if we were to test many other samples of fifteen subjects drawn randomly from the same population.

Just as we use a model, the normal distribution, to represent the bell-shaped curve we expect from a large sample of measurements, so we use a model, the F distribution, to represent the sampling distribution we expect from a large number of F ratios. The F distribution is not normal; its form depends upon the number of degrees of freedom upon which the two estimates are based. But the F distribution can be used, as the normal distribution can, to make a probability statement. Just as we use the normal distribution to determine how often a difference between two means would occur by chance, we can use the F distribution to determine how often a given F ratio, greater than 1, would occur by chance.

The value of F obtained in the memory experiment was 4.74. To determine whether this value of F is significant, a table is used which is based upon the number of degrees of freedom in the numerator and the denominator of the F ratio. These tables are found in most statistics textbooks and reference books. The F ratio in the memory experiment has 4 degrees of freedom in the numerator and 10 degrees of freedom in the denominator. Using these values, we can determine from a table the following probabilities:

Probability under Null Hypothesis	Value of F
.05	3.48
.01	5.99

These figures mean that an F value of 3.48 would occur by chance 5 per cent of the time. Put another way, only 5 per cent of the ratios in this F distribution are greater than 3.48, just as only 5 per cent of the scores in a normal distribution are more than 1.96 standard deviations from the mean. Since the obtained F ratio is larger than 3.48, we can be at least 95 per

cent certain that the obtained F value is not due to chance. We therefore reject the null hypothesis at the .05 level. We conclude that diet does affect memorizing performance. We know that in a series of experiments, such a conclusion based upon evidence this strong will be incorrect less than 5 per cent of the time.

Analysis of Covariance

In the above experiment, the null hypothesis was rejected at the .05 level. If the experimenter had established the .01 level as a criterion for rejecting the null hypothesis, he would not have considered the results significant. He would have concluded that variation in diet did not reliably affect memorizing performance, but because the F ratio was fairly high, he might have suspected there was an effect that was not quite demonstrated in his experiment. How could he have altered the experimental design in order to be more likely to reject the null hypothesis if it were in fact false? One way would be simply to use more subjects in the experiment.

The larger the number of subjects used, the more degrees of freedom. Within samples, the number of degrees of freedom is equal to $N-k$. An increase in N , the total number of subjects, would therefore increase the degrees of freedom within samples. Remember that the value of F which is required for significance at a particular level is dependent upon the degrees of freedom in the experiment. This relationship is inverse. The more degrees of freedom involved, the lower is the value of F which is required to reject the null hypothesis at a particular level of significance. This makes sense because we would expect to get a better estimate of the population variance by using larger samples. However, using more subjects in an experiment of this type is expensive, and there is another way by which the experimenter can improve the sensitivity of his experiment. If he can reduce the error variance, the variance due to the independent variable is more likely to stand out.

Remember that the error variance is due to the effects of variables which are controlled by randomization. In the previous experiment

these variables are mainly subject variables. If the experimenter could measure some of these subject variables, he could then correct the dependent variable for a portion of the individual differences. To do this he could administer a memory test to all of the subjects before the experiment begins. If this test had a high correlation with the dependent variable, he could predict the score each subject would obtain on the dependent variable under the null hypothesis. He could then remove some of the error variance in the experiment by correcting the dependent variable for differences in the subjects' ability as measured by the memory test. The score on the memory test would thus be used as a *control variable*. We have already seen that relevant variables can be controlled by *holding constant* and by *randomization*. This new type of control is called *statistical control*. The procedure used is *analysis of covariance*. It might be viewed as a sort of blending of analysis of variance and correlation. The exact computational procedures are somewhat complex and beyond the scope of this already complicated discussion.

Two-Way Analysis of Variance

We have seen how analysis of variance can be used to assess the effect of one independent variable upon a dependent variable. In this analysis the values of the dependent variable were classified according to the diet (independent variable). This is called a one-way classification because only one independent variable is involved. The analysis used is called *one-way analysis of variance*. In such an analysis, the sample variance is broken into two components, *within variance* and *between variance*. Both of these components of variance are used to estimate population variance. If the between variance is sufficiently greater than the within variance, we conclude that something other than chance was operating. In a well-controlled experiment, this would have to be the effects of the independent variable.

Analysis of variance can be used to study the effects of more than one independent variable at a time. This is done by partitioning the sample variance into several components and using

each of these to estimate the population variance. The partitioning is done in such a way that one component, the within variance, is an unbiased estimate of the population variance. That is, it is not influenced by the effects of the independent variables. Each other component is influenced by error variance plus the variance due to one particular effect. This might be the effect of one particular independent variable or the effect of *interaction* between variables.

Let us consider an experiment in which there are two independent variables. In such an experiment, each subject is classified not according to one independent variable, but according to two. This is called a *two-way classification*. The analysis used is *two-way analysis of variance*. Let us consider an example.

An experimenter wishes to study the effects of anxiety upon test performance. He is particularly interested in finding out whether anxiety affects highly intelligent people the same way it affects duller people. He will therefore have two independent variables: anxiety and intelligence. His dependent variable will be the score on a test. He decides to use two levels of anxiety and three levels of intelligence in his experiment. His subjects will be twenty-four students enrolled in a general course in psychology. He defines intelligence operationally as the score they obtained at the beginning of the semester on a standardized intelligence test. He decides to use different types of instructions to induce different anxiety levels in the subjects. At the top of the test papers for the high-anxiety group he puts instructions to the effect that they must do as well as they can because the score on the test will be very important in determining their grade in the course. On the test papers for the low-anxiety group, the instructions state that the purpose of the test is for the students to find out how well they are doing in the course, and that the scores will not be used in determining grades. These are two different types of experimental variation. Intelligence was varied by *selection of subjects*. Anxiety was varied by *instruction*. He will have a total of six experimental groups: two anxiety levels times three intelligence levels. This is called a 2×3 *factorial design*. When the independent variables are studied in all possible combinations in the same experiment, the experiment is said to be a

TWO-WAY ANALYSIS OF VARIANCE

Intelligence Level	Anxiety Level		Mean of Rows \bar{X}_r
	Low	High	
High	11	14	10
	9	12	
	9	10	
	7	8	
			$\bar{X} = 9$ $\bar{X} = 11$
Middle	9	9	7
	8	7	
	6	7	
	5	5	
			$\bar{X} = 7$ $\bar{X} = 7$
Low	7	5	4
	5	4	
	5	2	
	3	1	
			$\bar{X} = 5$ $\bar{X} = 3$
Mean of Columns \bar{X}_c	7	7	Grand Mean $\bar{X}_t = 7$

Number of replications: $n=4$ Number of rows: $r=3$ Number of columns: $c=2$

Sum of squares for total variance:

$$\Sigma(X - \bar{X}_t)^2 = (11-7)^2 + (9-7)^2 + (9-7)^2 + \dots + (4-7)^2 + (2-3)^2 + (1-7)^2 = 224$$

Sum of squares between rows:

$$nr[\Sigma(\bar{X}_r - \bar{X}_t)^2] = 4 \times 2 \times [(10-7)^2 + (7-7)^2 + (4-7)^2] = 144$$

Sum of squares between columns:

$$nr[\Sigma(\bar{X}_c - \bar{X}_t)^2] = 4 \times 3 [(7-7)^2 + (7-7)^2] = 0$$

Sum of squares within groups:

$$\Sigma(X - \bar{X}_r)^2 = (11-9)^2 + (9-9)^2 + (9-9)^2 + \dots + (4-3)^2 + (2-3)^2 + (1-3)^2 = 64$$

Sum of squares for interaction:

$$\begin{aligned} &\Sigma(X - \bar{X}_t)^2 - nr[\Sigma(\bar{X}_r - \bar{X}_t)^2] - \\ &nr[\Sigma(\bar{X}_c - \bar{X}_t)^2] - \Sigma(X - \bar{X}_r)^2 = \\ &224 - 144 - 0 - 64 = 16 \end{aligned}$$

factorial design. There will be four subjects in each of these six experimental groups. That is, each combination of anxiety and intelligence is represented four times. These are called *replications*. The complete description of his design would therefore be: a 2×3 factorial design with 4 replications. Note that the product of the number of levels of each independent variable and the number of replications is equal to the number of subjects: $2 \times 3 \times 4 = 24$. He assigns the subjects to high- or low-anxiety groups, using a table of random numbers or some other method of randomization, and administers the test. The results are shown in the figure.

There are several types of variance involved in this experiment. First, there is the total variance. This is determined by subtracting the

grand mean from each of the 24 scores in turn, squaring these deviations, adding them, and dividing by the number of degrees of freedom ($N-1$). Since the variance is intended to be an estimate of population variance, the division is by degrees of freedom, rather than number of cases.

The total variance can be divided into components. One component of variance is the variance of the means of the three intelligence levels about the grand mean. Since there are three means involved in this computation, there will be $3-1=2$ degrees of freedom. Another component of variance is the variance of the means of the two anxiety levels about the grand mean. There are two means involved in this computation, so the number of degrees of freedom is $2-1=1$.

A third component is the variance of the individual scores about their group means. This within group (error) variance is estimated by pooling together the variance within each group. For example, from each of the scores in the high intelligence-high anxiety group, we subtract the mean of the high intelligence-high anxiety group. We do this for all six groups, square these deviations, add them up, and divide by the number of degrees of freedom. The number of degrees of freedom is equal to the total number of scores minus the total number of means used in the computation. This is equal to $24 - 6 = 18$.

Let us consider further the various numbers of degrees of freedom. The estimate of total variance, which involves each of the 24 dependent variable scores, is based upon 23 degrees of freedom. Some of this variance is due to the effects of intelligence. Some of it is due to the effects of anxiety. Some of it is due to random (error) effects. The table below shows what we have discussed thus far:

Source of Variance	Degrees of Freedom
Intelligence	2
Anxiety	1
Within (error)	18
Total	21

We see that thus far we have utilized 21 degrees of freedom in our three components of variance. Yet the estimate of *total variance* is based upon 23 degrees of freedom. Since total variance consists of the sum of all of its components, the number of degrees of freedom upon which total variance is based is equal to the number of degrees of freedom upon which the components are based. That is, the number of degrees of freedom for total variance is the sum of the number of degrees of freedom for all the components. There are two degrees of freedom not yet accounted for. What is this fourth component of variance? It is the *interaction* between the two independent variables. The interaction tells us the extent to which the effect of anxiety upon the dependent variable is different for each level of intelligence. Stated another way, it tells us how the effect of intelligence

upon the dependent variable is different for the two levels of anxiety. Although it is not readily apparent, these two statements mean exactly the same thing. The number of degrees of freedom upon which our estimate of interaction variance is based is equal to the product of the number of levels of intelligence minus one and the number of levels of anxiety minus one: $(3 - 1) \times (2 - 1) = 2$. These are the two degrees of freedom that have not yet been accounted for.

The formulas for estimating the components of variance are given in the figure on page 642. The sum of the squared deviations (sum of squares) for each component of variance has been computed. The sums are listed in the table below, which gives the results of the analysis as they are usually reported:

Source of Variance	Sum of Squared Deviations	Degrees of Freedom	Estimate of Population Variance	F
Intelligence	144	2	72	20.2*
Anxiety	0	1	0	0
Interaction	16	2	8	2.2
Error	64	18	3.56	

*Significant at the .01 level. Other *F*'s are not significant.

The source of the variance is listed in the first column, the sum of the squared deviations in the second. The sum of squares must be divided by the degrees of freedom (third column) to determine the variance (fourth column). The estimates of population variance, like those in the one-way analysis, are all estimates of the same thing. But as we have seen, the estimate based on error variance is an unbiased estimate while the estimates based on other sources include variation due to the effect of an independent variable (intelligence or anxiety) or variation due to the combined effect of the independent variables (interaction).

To assess the effects of intelligence, anxiety, and interaction, three *F* ratios are computed. In the numerator of each *F* ratio is the estimate of population variance based upon the effect being studied. Thus the numerator in the *F* ratio for intelligence is 72. All *F* ratios have the same denominator, which is the error variance (variance from within groups). These *F* ratios are listed in the last column of the table.

The F ratio for intelligence has 2 degrees of freedom in the numerator and 18 degrees of freedom in the denominator. For these values an F of 6.01 is required for significance at the .01 level. The obtained F ratio of 20.2 is therefore significant at this level. The F ratio of zero for anxiety is clearly not significant. In fact, it is even less than would be expected by chance. The F ratio for interaction, 2.2, is, like that for intelligence, based upon 2 degrees of freedom in the numerator and 18 degrees of freedom in the denominator. This falls short of significance even at the .05 level, for which a ratio of 3.55 is required.

The conclusions drawn from this experiment are: (1) intelligence is a factor affecting test scores; (2) anxiety has not been demonstrated to have an effect upon test scores; (3) the effect of intelligence upon test scores is not significantly different for the different levels of anxiety tested.

This short chapter has been an extremely quick survey of what is normally covered in a two-semester course in statistics. Most of the concepts are entirely new to the student, and perhaps overwhelming. Only the highlights have been covered, and these very briefly. Nonetheless, a thorough understanding of the material presented here will be of great assistance in interpreting the results of most published psychological research.

The student who pursues the study of psychology through the graduate level will probably take three or more full semester courses in statistical methodology. If he specializes in psychological measurement, he will take many more. In addition, he should study basic mathematics, including the calculus, probability, and matrix algebra. If such techniques seem unduly complex, bear in mind that they are infinitely simpler than the object of study of that science known as psychology.

Section B Frontiers in Psychology

THE PSYCHOLOGY OF THE PSYCHOLOGIST	ROBERT ROSENTHAL
PSYCHOLOGY AND CULTURAL DETERMINANTS OF BEHAVIOR	ABRAHAM MASLOW
THE CONCEPT OF EGO DEVELOPMENT	JANET LEVINE
EXPERIMENTAL MODIFICATION OF MEMORY STORAGE	JAMES L. MALBAUM
HUMAN PERFORMANCE	JOHN W. SENDERS
INTERNATIONAL COOPERATION AND ATTITUDE CHANGE	HERBERT C. KELMAN

Six leading psychologists here review what they consider the important "frontiers" in their fields of specialization, pointing out trends in theory and research and critical questions that need to be answered. In all of these fields there have been major breakthroughs in recent years. Yet they are not "new" fields, and a quarter of a century from now they will not

be considered "old" fields. As we add new discoveries to previous knowledge, achieving deeper insights and closer approximations to the truth, we view our achievements with justifiable pride. But no science can ever be written off as "complete"—and, perversely, we would be disappointed if it could, for there would then be no further "frontiers" to explore.

Robert Rosenthal Harvard University

THE PSYCHOLOGY OF THE PSYCHOLOGIST

Psychologists are said to be such a scientifically self-conscious group that there may one day be a psychology of those psychologists who study psychologists. That, for the most part, is in the future, but in the present there is a clearly developing psychology of the psychologist as he conducts his research with human and animal subjects.

The social situation which comes into being when an experimenter encounters his research subject is a situation of both general and unique importance to psychology and the other behavioral sciences. Its general importance derives from the fact that the interaction of experimenter and subject, like other two-person interactions, may be investigated empirically with a view to teaching us more about dyadic interaction in general. Its unique importance derives from the fact that the interaction of experimenter and subject, unlike other dyadic interac-

tions, is a major source of our knowledge in the behavioral sciences.

To the extent that we hope for dependable knowledge in psychology and the behavioral sciences generally, we must have dependable knowledge about the experimenter-subject interaction specifically. We can no more hope to acquire accurate information for our disciplines without an understanding of the data collection situation than astronomers and zoologists could hope to acquire accurate information for their disciplines without understanding the effects of their telescopes and microscopes. It is for these reasons that increasing interest has been shown in the investigation of the experimenter-subject interaction system. And the outlook is anything but bleak. It does seem that we can profitably learn of those effects which the experimenter unwittingly may have on the results of his research.

Experimenter Effects

It is useful to think of two major types of effects, usually unintentional, which the psychologist can have upon the results of his research. The first type operates, so to speak, in the mind, in the eye, or in the hand of the psychologist. It operates without affecting the actual response of the human or animal subjects of the experiment. It is not interactional. The second type of experimenter effect is interactional. It operates by affecting the actual response of the subject of the experiment. It is a subtype of this latter type of effect, the effects of the psychologist's expectancy or hypothesis on the results of his research, which will occupy most of the discussion. First, however, some examples of other effects of the psychologist on his research will be mentioned.

Observer effects. In any science, the experimenter must make provision for the careful observation and recording of the events under study. It is not always so easy to be sure that one has, in fact, made an accurate observation. That lesson was learned by the psychologists, who needed to know it, but it was not the psychologists who focused our attention on it originally. It was the astronomers.

Near the end of the 18th century Maskelyne, the royal astronomer at the Greenwich Observatory, discovered that his assistant, Kinnebrook, was consistently "too slow" in his observations of the movement of stars across the sky. When the errors continued, Kinnebrook was fired.

The man who might have saved that job was Bessel, the astronomer at Königsberg, but he was twenty years too late. In studying the observations of stellar transits made by a number of senior astronomers, Bessel discovered that differences in observation were the rule, not the exception (Boring, 1950).

That early observation of the effects of the scientist on scientific observations made Bessel perhaps the first student of the psychology of scientists. More contemporary research on the psychology of scientists has shown that, while observer errors are not necessarily serious, they tend to occur in a biased manner. That is, when errors of observation do occur, they tend to be in

the direction that supports the psychologist's hypothesis (Rosenthal, 1966).

Interpreter effects. The interpretation of the data collected is part of the research process, and a glance at any of the technical journals of contemporary psychology will suggest strongly that while psychologists only rarely debate the observations made by one another, they often debate the interpretation of those observations. It is as difficult to state the rules for accurate interpretation of data as it is for accurate observation of data, but the variety of interpretations offered in explanation of the same data imply that many of us must turn out to be wrong. The history of science generally, and the history of psychology more specifically, suggest that more of us are wrong longer than we need to be because we hold our theories not quite lightly enough. The common practice of theory monogamy has its advantages, however. It does keep us motivated to make more crucial observations. In any case, interpreter effects seem less serious than observer effects. The reason is that the former are public while the latter are private. Once a set of observations have been made, their interpretations become generally available to the scientific community. We are free to agree or disagree with any specific interpretation. Not so with the case of the observations themselves. Often these are made by a single investigator so that we are not free to agree or disagree. We can only hope that no observer errors occurred that time and we can, and should, repeat the observations.

Intentional Effects. It happens sometimes in undergraduate laboratory science courses that students "collect" and report data too beautiful to be true. (That probably happens most often when students are taught to be scientists by being told what results they must get to do well in the course rather than being taught the logic of scientific inquiry and the value of being quite open-eyed and open-minded.) Unfortunately, the history of science tells us that not only undergraduates have been dishonest in science. Fortunately, such instances are rare; nevertheless, intentional effects must be regarded as part of the inventory of the effects of the investigator himself.

Intentional effects, interpreter effects, and observer effects do not affect the subject's response to the experimental task. In the experimenter effects to be described next, we shall see that the subject's response to the experimental task is affected.

Biosocial Effects. The sex, age, and race of the investigator have all been found to affect the results of his research. What we do not know and what we need to learn is whether subjects simply respond differently to the presence of experimenters varying in these biosocial attributes or whether experimenters varying in these attributes behave differently toward their subjects and, therefore, obtain different responses from them because they have, in effect, altered the experimental situation for their subjects. So far, the evidence suggests that male and female experimenters, for example, conduct the "same" experiment quite differently; thus differences in their results may well be due to the fact that they unintentionally conducted different experiments. Male experimenters, for example, were found in two experiments to be more friendly to their subjects. Biosocial attributes of the subject can also affect the experimenter's behavior, thus in turn affecting the subject's responses. In one study, for example, the interactions between experimenters and their subjects were recorded on sound films. It was found that only 12 per cent of the experimenters ever smiled at their male subjects while 70 per cent of the experimenters smiled at their female subjects. Smiling by the experimenters was found to affect the results of the experiment.

Psychosocial effects. The personality of the experimenter has also been found to affect the results of his research. Experimenters who differ in anxiety, need for approval, hostility, authoritarianism, status, and warmth tend to obtain different responses from their experimental subjects. Experimenters higher in status, for example, tend to obtain more conforming responses from their subjects, and experimenters who are warmer in their interaction with their subjects tend to obtain more pleasant responses from their subjects.

Situational effects. Experimenters who are more experienced at conducting a given experiment obtain different responses from their subjects than do their less experienced colleagues. Experimenters who are acquainted with their subjects obtain different responses than do their colleagues who have never met their subjects before. The things that happen to the experimenter during the course of his experiment, including the responses he obtains from his first few subjects, can all influence his behavior, and changes in his behavior can lead to changes in his subjects' responses. When the first few subjects of his experiment tend to respond as they are expected to respond, the behavior of the experimenter changes in such a way as to influence his subsequent subjects to respond too often in the direction of his hypothesis (Rosenthal, 1966).

Modeling effects. It sometimes happens that before an experimenter conducts his study he tries out the task he will later have his research subjects perform. Though the evidence on this point is not all that clear, it would seem that at least sometimes, the investigator's own performance becomes a factor in his subjects' performance. When the experimental stimuli are ambiguous, for example, subjects' interpretations of their meaning may too often agree with the investigator's own interpretations of the stimuli.

Expectancy effects. Some expectation of how the research will turn out is virtually a constant in science. Psychologists, like other scientists generally, conduct research specifically to test hypotheses or expectations about the nature of things. In the behavioral sciences, the hypothesis held by the investigator can lead him unintentionally to alter his behavior toward his subjects in such a way as to increase the likelihood that his subjects will respond so as to confirm his hypothesis or expectation. We are speaking, then, of the investigator's hypothesis as a self-fulfilling prophecy. One prophesies an event and the expectation of the event then changes the behavior of the prophet in such a way as to make the prophesied event more likely. The history of science documents the occurrence of

this phenomenon with the case of Clever Hans as prime example (Pfungst, 1911, 1965).

Hans was a horse belonging to a German mathematics instructor. By tapping his foot, Hans was able to perform difficult mathematical calculations; he could spell, read, and solve problems of musical harmony. A distinguished panel of scientists and experts on animals ruled that no fraud was involved. There were no cues given to Hans to tell him when to start and when to stop the tapping of his foot. But of course there were such cues, though it remained for Oskar Pfungst to demonstrate that fact. Pfungst, in a series of brilliant experiments, showed that Hans could answer questions only when the questioner or experimenter himself knew the answer and was within Hans' view. Finally, Pfungst learned that a tiny forward movement of the experimenter's head was the signal for Hans to start tapping; a tiny upward movement of the head or a raising of the eyebrows was the signal to stop. The questioners expected Hans to give correct answers, and this expectation was reflected in their unwitting signal that the time had come to stop tapping. We turn now to a consideration of more recent experiments which show that an investigator's expectation can come to serve as self-fulfilling prophecy.

Recent Studies of Expectancy Effects

To demonstrate the effects of the investigator's expectancy on the results of his research, at least two groups of experimenters are needed, each group with a different hypothesis or expectancy as to the outcome of its research. One approach might be to do a kind of census or poll of actual or potential experimenters in a given area of research in which opinions as to relationships between variables were divided. Some experimenters expecting one type of result and some experimenters expecting the opposite type of result might then be asked to conduct a standard experiment. If each group of experimenters obtained the results they expected, we could conclude that the expectation of the experimenter does indeed affect the results of his research. Or could we? Perhaps not.

The problem would be that experimenters who differ in their theories, hypotheses, or expectations might very well differ in other related ways. The differences in the data they obtained might be due, then, not to differing expectations but to other variables correlated with expectations.

A better strategy, therefore, would be to "create" two groups of experimenters differing only in their hypotheses or expectations about the results of a particular experiment. This plan was employed in the following research.

Ten advanced undergraduates and graduate students of psychology served as the experimenters. All were enrolled in an advanced course in experimental psychology and were, therefore, already involved in conducting research. Each student experimenter was assigned as his subjects a group of about twenty students of introductory psychology. The experimental procedure was for the experimenter to show a series of ten photographs of people's faces to each of his subjects individually. The subject was to rate the degree of success or failure shown in the face of each person pictured in the photos. Each face could be rated as any value from -10 (extreme failure) to $+10$ (extreme success). The 10 photos had been selected so that, on the average, they would be seen as neutral, with an average numerical score of zero.

All ten experimenters were given identical instructions on how to show the photographs to their subjects and were given identical instructions to read to their subjects. They were told that the purpose of the study was to see how well they could duplicate experimental results which were already well established. Half the experimenters were told that the "well-established" finding was that people generally rated the photos as of successful people ($+5$) and half were told that people generally rated the photos as being of unsuccessful people (-5).

Every experimenter who had been led to expect positive ratings obtained a higher average rating than did any experimenter expecting negative ratings. Because such clear-cut results are not common in behavioral research, two replications were conducted. Both these subsequent experiments gave the same result: experimenters tended to obtain the data they expected to obtain.

Subsequent experiments in this program of research were designed not so much to demonstrate the effects of the psychologist's expectancy as to learn something about the conditions which increase, decrease, or otherwise modify these effects.

Through the employment of accomplices, serving as the first few subjects, it was learned that the responses of the first few subjects apparently altered the experimenter's behavior toward his subsequent subjects in such a way as to affect their responses. When the accomplices intentionally confirmed the expectation of the student experimenter, the bona fide subjects subsequently contacted also confirmed his experimental hypothesis. When the accomplices disconfirmed the experimenter's "expectation," the actual subjects disconfirmed it. It seems possible, then, that the results of behavioral research can be determined by the performance of just the first few subjects.

In some of the experiments conducted, it was found that when experimenters were offered a too-large and too-obvious incentive to affect the results of their research, the effects of expectancy tended to diminish. It speaks well for the integrity of our student experimenters that when they felt bribed to get the data we led them to expect, they seemed actively to oppose us. There was a tendency for these experimenters to "bend over backward" to avoid the biasing effects of their expectation—bending so far backward that the results of their experiments tended to be significantly opposite to the results they had been led to expect.

Individual differences among experimenters in the degree to which they obtain results consistent with their hypothesis have been discovered. The evidence comes both from additional experiments and from the analysis of sound motion pictures of experimenters at work. Those experimenters who show greater expectancy effects tend to be of higher status in the eyes of their subjects and they conduct their experiments in a more professional, competent manner. They are more likable and more relaxed, particularly in their movement patterns, while avoiding an overly personal tone of voice that might interfere with the business at hand. It is interesting to note that even when the influence of an experimenter's expectancy is

quite unintentional, the characteristics of the more successful influencer are very much the same ones associated with more effective intentional influence, as in the case of outright persuasion attempts.

The process whereby the experimenter communicates his expectancy to his subject is a subtle one. We know that it is subtle because for four years we have tried to find in our sound films the unintended cues the experimenter gives the subject—and for four years we have failed. But there are some things about the unintentional communication of expectancies that have been learned.

We know, for example, that if a screen is placed between experimenter and subject there will be a reduction of the expectancy effect—so visual cues from the experimenter must be important. But the interposed screen does not quite eliminate expectancy effects—so auditory cues are probably also important.

It has been suggested that a process of operant conditioning might be responsible for the operation of expectancy effects. That is, every time the subject gives a response consistent with the experimenter's hypothesis, the experimenter might look more pleasant, or smile, or glance at the subject approvingly, thus inadvertently reinforcing the desired responses. Several experiments were analyzed to see whether this hypothesis of operant conditioning might apply. If it did apply, we would expect that the subjects' responses gradually became more like those desired by the experimenter—that there would be a learning curve for subjects. No such curve was found, however. On the contrary, it turned out that the subjects' very first response was about as much affected by their experimenter's expectancy as was their very last response. Since the very first response, by definition, cannot follow any unwitting reinforcement by the experimenter, the mechanism of operant conditioning can be ruled out as necessary to the communication of experimenters' expectancies.

While there was no learning curve for subjects, there did seem to be a learning curve for experimenters. Several studies showed that expectancy effects became more pronounced as more subjects were contacted by each experimenter. In fact, there was very little expectancy effect in evidence for just the very first-seen sub-

jects. If the experimenter were indeed learning to increase his unintended influence, who would be the teacher? Quite probably the subject. It seems reasonable to think of a subject's responding in the direction of the experimenter's hypothesis as a reinforcing event. Therefore, whatever covert communicative behavior of the experimenter preceded the subject's reinforcement becomes more likely to recur. Subjects, then, may quite unintentionally shape the experimenter's unintended communicative behavior. Not only does the experimenter influence his subjects to respond in the expected manner, but his subjects may well evoke just that unintended behavior that will lead them to respond increasingly as expected. It is probable that neither subject nor experimenter "knows" what the unintended communication behavior is; it is certain that the writer does not.

Some Implications

The implications of the research on the effects of the experimenter's expectancy on the results of his research are of two general kinds: those that are primarily methodological and those that are more substantive. Our focus here will be more on some of the substantive implications, but brief mention may be made of some implications for methods of conducting research in psychology.

To the extent that the results of experiments in psychology are affected by the expectation of the experimenter, we can only place a lessened confidence in these results. But to say that our confidence is weakened in the results of many experiments as they are actually conducted is not to say that our confidence is weakened in the basic logic of the experimental method. We must simply take those, only sometimes inconvenient, extra precautions required to prevent expectancy effects or to reduce them or at least to permit us to assess whether they have or have not affected the results of our research.

It is possible for research investigators to employ, as data collectors, research assistants who have not been told the purpose of the research. As long as the investigator's expectation can be kept from these data collectors, there should be no effects attributable to the investigator's expectation. There are some experiments in

which the experimenter need have no direct contact with the subjects and, in such studies, automated data collection systems should be employed to reduce any possibility of the unintended influence of the experimenter's expectation. When a human data collector is required—and that is often the case—at least the amount of contact between experimenter and subject can be reduced in order to minimize any opportunity for unintended communication.

Not only because of the danger of expectancy effects but also because of the general nature of other experimenter effects, it would be desirable to employ larger numbers of experimenters for each study than are now routinely employed. That would permit the assessment of the extent to which different experimenters obtained different results and, in any area of psychological research, that is a fact worth knowing.

Only one final technique for the control of expectancy effects can be mentioned here and that is the employment of special control groups known as "expectancy controls." In any experiment employing an experimental (treatment) and a control (no treatment) condition, two extra groups are added. In one of these added groups, the data collector is led to believe that no treatment has been administered when, in fact, it has. In the other added group, the data collector is led to believe that the treatment has been administered when, in fact, it has not. Such a research design permits the assessment of the effects in which the investigator is primarily interested as well as the assessment of the magnitude or complicating effect of the experimenter's expectancy (Rosenthal, 1966).

Beyond the laboratory. Perhaps the most compelling and the most general substantive implication of the research described here is that human beings can engage in highly effective and influential unintended communication with one another. More specifically, if we may generalize from experimenters to people more generally, it appears that one person's expectancy for the behavior of another may come to serve as a self-fulfilling prophecy. These implications invite further research. We will want

to know how people communicate with one another nonverbally and unintentionally. We will want to know whether in everyday life predictions become realities by the very act of prediction. When an experienced physician or psychotherapist tells the neophyte therapist that the neophyte's patient has a good or a poor prognosis, is the experienced clinician only assessing, or is he actually creating the poor or good prognosis? When the employer tells the employee that a task cannot be accomplished, does the accomplishment therefore become more likely? When a respected source suggests to a teacher that a child's intellectual ability will show marked gains, will that prophecy be self-fulfilled? There are no answers to most of these research questions, except to the last, but before we discuss that experiment beyond the laboratory, let us return briefly to the lab for some background data.

In the course of the research program on expectancy effects, it seemed important to learn whether these effects occurred only when the experimental subjects were humans. Accordingly, twelve experimenters were each given five rats who were to be taught to run a maze with the aid of visual cues. Half the experimenters were told their rats had been specially bred for maze-brightness; half the experimenters were told their rats had been bred for maze-dullness. Actually, of course, there were no differences in the rats. At the end of the experiment, the results were clear. Rats who had been run by experimenters expecting brighter behavior showed significantly superior learning compared to rats run by experimenters expecting dull behavior (Rosenthal and Fode, 1963). The experiment was repeated, this time employing a series of learning experiments, conducted with Skinner boxes. Half the experimenters were led to believe their rats were "Skinner-box bright," and half were led to believe their animals were "Skinner-box dull." Once again there were not really any differences in the two groups of rats, at least not until the end of the experiment. Then the allegedly brighter animals really were brighter; the alleged dullards really duller (Rosenthal and Lawson, 1964).

If rats became brighter when expected to by their experimenter, it seemed possible that children might become brighter when ex-

pected to by their teacher. Educational theorists had, after all, been saying for a long time that culturally disadvantaged children were unable to learn because their teachers expected them to be unable to learn. The following experiment was conducted to test that theory (Rosenthal and Jacobson, 1967).

All of the children in an elementary school were administered a nonverbal test of intelligence, which was represented to the teachers as a test that would predict intellectual "blossoming." There were eighteen classrooms in the school, three at each of the six grade levels. Within each grade level the three classrooms were composed of children with above-average ability, average ability, and below-average ability, respectively. Within each of the eighteen classrooms approximately 20 per cent of the children were chosen at random to form the experimental group. Each teacher was given the names of the children from her class who were in this group and told that their scores on the "test for intellectual blossoming" indicated that they would show remarkable gains in intellectual competence during the next eight months of school. The only difference between the experimental group and the control group children, then, was in the mind of the teacher.

At the end of the school year, eight months later, all the children again took the same IQ test. In the grades three through six there were no differences in IQ gains between the children of the experimental and control groups, but the results for the first two grades were impressive. In the first grade, children from whom gains were expected gained over 15 more IQ points than did the children of the control group. In the second grade, the children from whom gains were expected gained nearly 10 more IQ points than did the children of the control group. To put these results in another way, 47 per cent of the experimental children as compared with 19 per cent of the control children gained 20 or more IQ points. Interestingly, the children of above-average ability and those of average ability were as much benefited by the teachers' favorable expectations as were the children of below-average ability.

This experiment shows that the effects of one person's expectancy for another's behavior on that other's behavior are not confined to the

laboratory. But where before we were left wondering how experimenters communicated their expectations to their subjects, we are now left wondering how teachers communicate their ex-

pectancies to their pupils, and that second question has popped up before we could even answer the first. Neither question will be easy to answer but both deserve the effort.

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PHYSIOLOGICAL AND CULTURAL DETERMINANTS OF BEHAVIOR

Current research emphasizes the extreme importance of both innate physiological and acquired cultural factors in human development. We are beginning to learn a few of the fascinating details of the ways in which physiological nature and cultural nurture interact to produce behavior. But the picture is not a simple one, and each new discovery discloses additional tantalizing problems, challenging us to advance scientific knowledge deeper into the vast unknown.

Behavioral scientists are beginning to learn something of how the brain works. The human brain has at least 10^{10} neurons, many of which have thousands of complex branches, resulting in a total of at least 10^{18} (a million times 10 million) synaptic connections. Many of these myriad connections appear to be innately determined. They provide an essential basis for aspects of everyday behavior which all of us casually take for granted. One of these is recognizing a horizontal line. This is not as simple as one might think, because as one's head and eyes move, the same horizontal line stimulates quite different arrays of points on the retina. We are beginning to learn something of how such perception is achieved.

Using microelectrodes to record the activity of individual neurons, Hubel and Wiesel (1963) find in the visual cortex single nerve cells that fire whenever a specific horizontal line on the retina is illuminated. Presumably the

many different receptors stimulated by the points on this specific line are each connected to this cell. Other cells fire when specific horizontal lines in other locations are illuminated. These cells do not respond to general changes in illumination or to small patches on the line. Yet other cells will fire whenever *any* horizontal line is illuminated. Presumably each of these neurons receives connections from many cells each responding to different horizontal lines. Because of the uniformity with which such cells are arranged in orderly columns, their connections presumably are largely innately predetermined, although experience is necessary for certain other aspects of complex visual perception.

Similar arrangements are found for responding to lines oriented in other directions and to a considerable number of other salient features of the visual world. This work begins to give us an idea of how a multitude of specific connections in the brain abstract information from the stimulation of individual rods and cones and allow us to respond to more general attributes, such as a line running in a specific direction.

You have seen how one aspect of the innate organization of the brain provides a basis for everyday behavior. There are many other such examples. Even at the level of human social behavior, we may have many organized patterns, analogous to those which have been studied by the ethologists, which have not yet been recognized as instinctual because they are overlaid by social learning.

Our understanding of the mechanism of innate organization of the nervous system is

This essay is condensed from an article of the same name appearing in the *Proceedings of the National Academy of Sciences*, 1964, 51, 941-954. Used by permission.

being increased by recent research on lower animals. In one type of work Sperry and his associates cut the optic nerve, manipulate it in various unusual ways, and then observe the process of regeneration (Arora and Sperry, 1962; Attardi and Sperry, 1963). When the eye of a frog is turned upside down, the fibers regenerating from the nerve cells in the retina do not grow along the nearest old path or remain in the same spatial relationship to each other. They are not guided by adaptive function. Instead, each of the 400,000 nerve fibers curves around to establish essentially the same connection that it had before, producing an orderly visual field which in this case is maladaptively inverted so that for the rest of its life the frog's tongue will snap downward when a fly buzzes by above. Recent experiments on the regeneration of cut optic nerves of fishes have shown that even when the fibers are forced to detour and pass through abnormal routes in the brain, they will curve back to arrive at their preordained destination.

Such results make a number of older theories untenable and show that various parts of the embryo must differentiate into some fantastically specific coding system with appropriate matches between the more than a million receptors in the peripheral sense organs and the corresponding cells in the brain so that each of the connecting fibers will be guided to grow to the correct destination. Reflection on how a single fertilized egg cell can develop to produce these results gives one a deeper appreciation of the wonderful process of differentiation and orderly growth.

You have had a glimpse of one kind of research that is helping us to understand how the brain is organized and functions in the processing of information. Research on this and other functions is giving us a new picture of the brain. We know that the all-or-none conduction of the long nerve fibers called axons does not apply to the synapses which connect one nerve cell with another and are especially prevalent in the brain. Here the transmitting tip of an axon acts like a gland to secrete a chemical transmitting substance, such as acetylcholine, to achieve a finely graded response which may be either excitatory or inhibitory. These conclusions are founded on converging evidence from many

techniques. Some of this work has been done by biophysicists who thrust micropipettes with several barrels into a single nerve cell, using a conductive solution in one pipette to record the electrical activity of the cell, while minute quantities of various chemicals are injected electrophoretically via the other barrels. Studies with the electron microscope have verified other details. Yet other studies have used a push-pull cannula to wash out and measure for a group of nerve cells the greater production of the transmitter, acetylcholine, when they are active than when they are not (Eccles, 1964; Gaddum, 1963).

The behavioral effects of stimulating considerable populations of cells in certain locations of the brain have been studied by Grossman (1962). Under anesthesia he implanted a tiny cannula, through which chemicals could later be introduced to specific sites in the brain of the normally behaving, unanesthetized animal. His studies have shown that after a rat has been thoroughly satiated on both food and water, injecting a minute amount of acetylcholine or of carbachol directly into a certain part of the brain will cause it to drink, while epinephrine or norepinephrine injected into the same site will cause the same satiated rat to eat. A series of control studies support the most obvious interpretation of these results, namely, that the neuromechanisms involved in the motivations of hunger and thirst are chemically coded.

Other fundamental changes in our ideas of the brain come from a study of the reticular formation, the central core of the brain which is characterized by a multitude of short interconnections in contrast with the longer fibers involved in the classical, more peripheral, sensory and motor systems which have long been understood. The study of this system and related nuclei has changed our concept of sleep. We now know that there is a wakefulness region of the brain. If this is damaged, the animal remains permanently somnolent. But there are also two different sleep centers. Instead of activating the animal, stimulation of these centers puts him to sleep. One center is responsible for a distinctive form of light sleep and the other for deep sleep. We no longer think of sleep as an over-all decrease in the activity of the brain. We know that the rate of spontaneous firing of

many cells is increased during sleep. The decreased responsiveness to external stimulation seems to be a change in the signal-to-noise ratio, which is produced more by increased noise than by decreased signal (Magoun, 1963).

The brain used to be thought of as a passive switchboard, activated only when stimulated by the peripheral sense organs. Now we know that each signal impinges on a background of ongoing activity, is modified by this activity, and in turn modifies it. In addition to the pathways coming in from the sense organs are fibers carrying impulses from the brain to the sense organs. These impulses from the brain can either increase the rate of firing of a specific class of sense organs or decrease it. Impulses from the brain can also affect various relay points between the sense organs and the highest levels of the brain. In this way the brain can control its own input.

The mechanism I have just described gives us a physiological basis for some of the psychological phenomena of attention, an area in which there has been a great deal of recent research at the purely behavioral level. This purely behavioral research has discovered many lawful relationships for which the brain mechanisms have not yet been identified, although carefully controlled experiments have demonstrated that many of the phenomena, such as your capacity to listen selectively to either one of two equally loud conversations at a cocktail party, must occur centrally in the brain rather than peripherally in the sense organs (Broadbent, 1958).

In addition to its obvious relationship to the eyes, ears, nose, and taste buds that sense the external world, the brain is now known to contain within itself specialized receptors for sensing the internal state of the body. For example, by using a thermode to heat or cool a tiny specific region of the anterior hypothalamus, which is a primitive part of the brain, and by recording from there with microelectrodes, Nakayama, Hammel, Hardy, and Eisenman (1963) have found that the majority of neurons are relatively unaffected by moderate changes in their temperature. However, there are some neurons here that increase their rate of firing when they are slightly heated, and others that increase their rate when they are slightly cooled.

These cells seem to serve as, or be connected to, specialized "sense organs" for measuring small changes in the temperature of the surrounding blood.

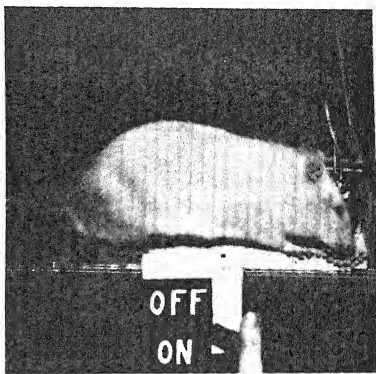
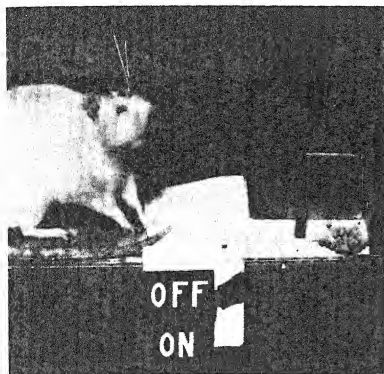
Heating this region of an animal's brain causes panting and increased blood supply to the skin which serve to lower the body temperature. Cooling it causes the opposite effect of shivering and decreased blood supply to the skin. It also stimulates the secretion of the thyroid, which in turn speeds up the body's burning of fuel. In the experiments in which only this tiny region of the brain is cooled, these effects produce a fever, but when the whole body is cooled under normal conditions, they serve to restore the animal's temperature to normal. This is one example of a homeostatic mechanism that causes the internal environment to be held at an optimal level, in this case a constant level of temperature.

The regulative effects that I have just described are relatively direct. But the beautiful picture is extended still further by the fact that cooling this region of the brain will make a satiated animal hungry, so that it will eat, whereas heating this region elicits drinking. Thus, this temperature-regulating mechanism is tied in with hunger and thirst, which motivate behavior that helps the animal to anticipate its needs for the fuel it will burn to keep warm, or the water it will evaporate to cool off.

In short, a whole series of homeostatic mechanisms ranging from changes in metabolism to the motivation of the behavior of seeking food or water is touched off by the cells in the brain that respond to temperature.

A considerable number of other homeostatic mechanisms are known to be involved in the motivation of specific types of behavior. For example, certain receptors in the brain respond to osmotic pressure so that a minute injection into the proper place in the brain of a solution that is slightly more salty than body fluid will motivate animals that have just been satiated on water to drink and also to perform responses that they have learned to get water. Under normal circumstances such drinking reduces the salinity of the body fluids to its proper level. Conversely, a minute injection of water will cause a dehydrated animal to stop drinking or working for water.

■ Electrical stimulation in the "feeding area" of the lateral hypothalamus causes a rat which has been satiated and hence is inactive (left) to go immediately to the right place and perform the learned habit of pushing back a hinged panel to get the pellets of food hidden behind it (right).



Yet other cells of the brain respond to specific hormones so that activities such as nest-building in rats can be elicited by injecting a minute quantity of the proper hormone into the correct site in the brain. Hormones can also exert an inhibitory effect on specific areas of the brain without affecting other areas. Thus the progestational steroids normally secreted by the ovary during pregnancy inhibit that part of the hypothalamus responsible for stimulating the pituitary to release the gonadotropic hormone which leads to ovulation. This hormone does not inhibit, however, other parts of the brain which are involved in sexual motivation, sexual performance, or sexual pleasure. A similar synthetic compound is used in oral contraception, a technique which would be considerably less attractive if this hormone's action on different parts of the brain were less specific.

Motivation has been mentioned a number of times. One of the exciting developments in recent years has been the rapid advance in our understanding of the brain mechanisms involved in certain basic motivations such as hunger and

thirst. A combination of physiological and psychological techniques has been especially fruitful. In the photograph on the left you see a rat that has learned when hungry the habit of pushing back a little panel to get food. ■ Since this rat has just been thoroughly satiated on food, it is not performing this habit. But as soon as the experimenter presses a key, as in the right-hand photograph, to stimulate a feeding center in the rat's brain with approximately 15 millionths of an ampere of current, hunger is elicited so that the rat promptly performs the learned habit of going directly to the right place and pushing open the panel to get the pellets of food hidden behind it. He does this repeatedly. As soon as the brain stimulation is turned off, the rat stops performing this habit. Stimulation of this part of the brain can also motivate a rat which has just been satiated on food to learn where to find food. Different tests of this kind prove that such stimulation elicits more than reflex eating; it functions just like hunger in motivating different types of learned food-seeking behavior (Miller, 1963).

Another advance has been the development of purely behavioral techniques for the laboratory study of nonhomeostatic motivations, such as curiosity, the affection of the infant monkey for its mother, and the desire of a human child for social approval (Berlyne, 1960; Gewirtz and Baer, 1958; Harlow and Zimmerman, 1959). Progress in such research may be expected to continue; eventually a great deal more will be known about how to stimulate, instead of stultify, intellectual curiosity in the classroom and how to arrange the social situation so that the strong influence of the classmates will favor, instead of conflict with, the goals of the parents and teachers.

I have sampled our scientific understanding of how the brain processes information, how it exerts a control over its own input, how it contains sense organs to help it to regulate the internal environment, and how it is involved in motivation. Let me turn now to certain recent knowledge about how we react to stress. Under stress, certain parts of the hypothalamus function as a gland to secrete substances which are carried by the blood stream and excite specific sites on the pituitary gland, causing it to secrete ACTH, which in turn causes the cortex of the adrenals to excrete ACH, which is one of the factors that causes the stomach to secrete hydrochloric acid. Under extreme circumstances, this acid and other effects of the complex reaction to stress are involved in producing ulcers in the stomach. Experimental studies have shown that direct electrical stimulation of appropriate areas of the hypothalamus can produce such ulcers (French, Porter, Cavanaugh, and Longmire, 1954).

Clinical observations suggest that chronic psychological stress can produce ulcers. These observations are confirmed by a variety of experiments in which various animals have been subjected to situations involving difficult decisions, or conflict between approaching a place to get food when hungry and staying away from it to avoid electric shocks. These experiments have shown that such psychological conditions, which presumably produce stress by activating the hypothalamus via the cortex, can elicit the pituitary-adrenal mechanism just described, increase the secretion of hydrochloric acid, and also produce ulcers (Miller, 1963; Polish, Bra-

dy, Mason, Thach, and Niemeck, 1962).

The same general stress mechanism seems to be involved also, along with many other factors such as the level of cholesterol and sodium chloride, in the development of arteriosclerosis, and in the production of high blood pressure. Such conditions have been produced by prolonged electrical stimulation of the hypothalamus and also by subjecting animals to psychological stresses which presumably initiate a similar chain of physiological reactions (Gunn, Friedman, and Byers, 1960; Miller, Pfaffman, and Schlosberg, 1962). Other studies are indicating that cultural conditions producing psychological stress can contribute to the physical symptoms of chronic high blood pressure. Scotch (1963) has shown that members of the Zulu tribe, living in villages in which their culture is relatively unaltered, have a very low rate of hypertension. Those who have been moved to cities where their old culture patterns have been disrupted have an excessively high rate. For both groups, the occurrence of hypertension is correlated with sociological variables presumably involved in stress, but these are different under the two sets of cultural conditions. Somewhat similar correlations between sociological conditions producing stress and hypertension have been suggested by studies of the Negroes in the Chicago area (Stamler, 1964). These are pioneering studies; their results must be accepted with some caution. More penetrating studies of the roles of sociological variables in psychosomatic symptoms are in progress.

As more work is being done on various aspects of stress, the convergence among the results of experimental studies by physiologists, clinical observations by psychiatrists, experimental studies by psychologists, and cultural studies by sociologists and anthropologists is becoming increasingly impressive. The results from different disciplines are beginning to fit together into a significant pattern.

Thus far, we have primarily sampled recent knowledge about innate physiological determinants of behavior. One of the important innate capacities of higher animals is the ability to learn from experience. The great development of the human brain, which is disproportionately large in the areas representing the vocal appara-

tus, has been associated with a unique ability to learn and use language. Through language, the experience of one generation is passed on as a cultural heritage to the next. For long-lived organisms, the process of natural selection is extraordinarily slow. Within the individual's lifetime, the process of learning directly from the environment is much faster, but still limited. When the cumulative effects of the lifetime learning of multitudes of different individuals in each generation can be passed on as part of the culture, however, developments proceed with an entirely different order of magnitude of ever accelerating speed.

Man's mode of adjustment to the environment is pre-eminently cultural. When a lower animal moves into a colder ecological niche, it slowly evolves the capacity to grow a thicker fur; when man moves into a much colder climate, he invents warmer clothes and a better house.

For the ancient men who had a much poorer cultural heritage, the process of innovation was vastly slower. Man has been in existence for approximately a million years. It is unlikely that his brain has evolved significantly in the last 50,000 years, and perhaps not for much longer. But man did not develop agriculture until 10,000 years ago. It took him about 5000 more years to invent the wheel as a means of transportation, which as far as we know was invented only once and was never discovered by the Indians of North and South America, in spite of the fact that the Incas had paved roads! The steam engine as a source of industrial power was invented two hundred years ago, the aeroplane within the lifetime of many people still alive, and atomic energy and space vehicles still more recently. Compare the glacially slow initial progress with the torrent which you have seen during your own life. This is the effect of the cumulative heritage of culture.

Science is a recent product of this cultural development, one which is powerfully accelerating the process. Science flourishes only under certain cultural conditions. Remember what happened to Galileo for advocating the heliocentric hypothesis, how the early anatomists were prevented from dissecting cadavers, and the present activities of antivivisectionists. Modern science would be impossible without

an advanced educational system and a strong economic base.

To understand man we must study his culture as well as his physiology and psychology. The basic *principles* of human learning and behavior depend on the innate physiological structure of man. But in many cases we have not yet been able to relate these principles to the innate physiology and have found it most useful to study them at the purely psychological, or in other words, behavioral level; the discovery of the links to physiology will not eliminate psychology any more than the quantum mechanics of valences has eliminated the discipline of chemistry. On the other hand, the crucial *conditions* of human learning and behavior are being scientifically studied by anthropologists, sociologists, and other social scientists. In order to understand human behavior, one must know both the principles and the conditions. That is why the scientific study of culture is important.

It is often said that human behavior is unpredictable. This is not true. Under appropriate cultural conditions there is a high degree of predictability. Without such predictability, civilization would be impossible. Look around you in class tomorrow. It is safe to predict that no one will be sitting there naked. You might stop for a moment to think how much someone would have to pay you to make you undress in class. This will give you some idea of the power of culture.

How bad a pest would some elderly relative of yours have to be before you would kill him? That is the strength of the cultural taboo in our society against murder. In India, cows, monkeys, parrots, insects, and other pests ravage the crops of an undernourished population, making it extremely difficult to introduce efficient methods of modern agriculture which involve growing large fields of the same crop and hence invite multiplication of the pests that prey on that crop. Since the Hindu believes that any one of these animals might be the reincarnation of one of his relatives, he will not kill any of these pests. For him the sacredness of all animal life is more important than his own hunger for food. On the other hand, the Eskimo used to abandon his parents to certain death when they were too old to care for themselves, and the

aged parents asked to be killed in this way. These are but a few examples of the enormous power of the social conditions of culture.

The first emphasis of the social anthropologists was on the extreme diversity of cultures. They proved that an astonishing amount of human nature is the product of cultural conditions and hence is not the same everywhere. For example, there are some cultures in which different tribes have interacted for long periods without warfare, and in some cases even without military weapons. Peace is compatible with human nature.

Even within our own American society, we have various subcultures. In the different social classes, the ideas of what is right and what is wrong, the values placed on education, having an illegitimate child, aggression, saving money, and many other aspects of life are far more different than most of us realize. There also are regional differences in culture, as illustrated by recent events in the deep South. Certain occupational groupings are minor subcultures. Everyone takes his own immediate culture for granted, and greatly underestimates the degree to which others react differently, because everyone tends to associate with people from a similar cultural background.

As they have advanced beyond their initial descriptions, anthropologists have found that the fact that many radically different ways of doing things in other cultures are quite possible does not mean that it is a matter of indifference how things are done in a given culture. They have learned much about how the different parts of a given culture dovetail in a lawful, functional way, so that changes of certain aspects may be strongly resisted, and if forced, may produce repercussions throughout the society. To give a simple example, in the Trobriand Islands, instead of a husband supporting his wife, a brother supports his sister, and if his sister has the status of being married to a chief, she must be well provided for. Each chief had many wives which were the source of his economic power, enabling him to supply food and drink for work parties which accomplished essential civil projects such as hollowing out great logs to produce ocean-going canoes. When pressure from colonial administrators caused abandonment of polygamy, the chiefs lost the extra

income from having several brothers-in-law, they were too poor to throw work parties, their prestige and authority declined, and necessary civic tasks were neglected. A change in one aspect of the society had unexpected, far-reaching effects (Malinowski, 1922).

An additional example of the functional interdependence of various aspects of a culture comes from Murdock's (1949) comparative study of 250 societies, which also illustrates the modern trend toward quantitative work. In a statistical analysis he has found that different patterns of sexual taboos in these societies are highly correlated with the ways in which kinship terms, such as "Mother" or "Aunt," are applied to larger or smaller classes of maternal or paternal relatives. The various uses of kinship terms are related to family living arrangements—whether the bride moves in with the husband's relatives, the husband moves in with the bride's relatives, or both go off independently. These customs are in turn dependent upon economic behavior, for example, hunting versus agriculture. Murdock also has shown how those changes which are known to have occurred during the history of these societies progressed in a lawful sequence with the changes in economic behavior coming first, followed by changes in living arrangements, and then in kinship systems.

We have seen that cultural changes are occurring at an accelerated rate. There is less time now for different aspects of a society to adjust by the slow, blind processes of social trial-and-error which were sufficient in the past.

In the studies of the hypertension of the Zulus, we saw one symptom of the stress involved in changing from one culture pattern to another. Other effects of the disorganization produced by relatively milder changes are illustrated by the fact that in our own country problems of delinquency and crime have characteristically involved the children of the newest wave of immigrants. Yet other studies seem to show that certain sociological variables, especially social disorganization, are related to a higher rate of mental illness.

The functional relationships among the different parts of a society become especially important when attempts are made to introduce rapid technological changes in so-called

"underdeveloped" countries. The changes occurring in such countries today create an urgent need for us to apply what we know, and at the same time present unparalleled opportunities for increasing our scientific understanding of the dynamics of rapid social change.

I shall conclude with one more example illustrating the way in which different disciplines, ranging from the physiological to the cultural, have profitably converged on a behavioral problem. You will remember that culture must be learned by children and that such learning during childhood is a crucial link in passing it on from generation to generation. In addition to this general consideration, clinical observations have suggested that there may be certain critical periods in childhood during which experiences may have an especially profound and long-lasting effect.

These observations have been supported by recent experimental studies on animals. Imprinting can occur only during a limited period of the newly hatched bird's life (Mayr, 1964). Birds will not learn to follow an object if their first exposure is after the critical period. Female rats restrained from grooming themselves during a certain period of infancy do not show normal nest building in later life and will eat, instead of care for, their young. Similarly, monkeys reared with artificial mothers do not display normal maternal behavior in later life, and if isolated from other infant monkeys during a certain period of childhood will not acquire normal sexual behavior when adult. They also show other strikingly neurotic symptoms. Bottled sheep do not develop gregariousness, but graze alone. That genetic factors are also involved, however, is shown by the fact that not all mammals become as gregarious as sheep.

The critical periods involve the interaction of developing innate patterns with learning. Their occurrence is firmly established in certain lower animals but we need to know much more about the detailed processes involved, and their occurrence in human infants.

Evidence that there are such critical periods in the development of the human infant has been secured by taking advantage of experiments of nature in which illness or other unusual circumstances have forced the child to be separated from its mother and mother-surro-

gate. In many, but not all, cases such separation seems to have had serious consequences for adult personality, shifting it toward chronic mistrust, hostility, and delinquency (Bowlby, 1955).

Experiments have recently shown that there are critical periods also for psychosomatic effects. It is well known that petting infant rats causes them to grow larger than control litter mates, and also to be superior as adults in certain avoidance-learning tasks. Similar petting at a slightly later age does not produce these effects. At first it was thought that the effects of handling were analogous to those of expressions of parental affection. This turned out to be a far too flattering misconception of the rat's reaction to being picked up by man. Electric shocks were found to produce similar effects. This and other studies showed that the effects were stressful, involving the links from the hypothalamus to the pituitary to the adrenal that we have already described (Levine, 1962).

Furthermore, biochemical studies of adult animals showed that the brief handling during an early critical period had a permanent effect on the adult animal's physiological reactivity to stress, for example, the production of corticosteroids.

Additional studies are showing that there are critical periods of development during which the injection of certain hormones in minute amounts, which would be ineffective if injected at other times, can have permanent effects upon the rat's physiological development, which in turn have profound effects on behavior (Harris and Levine, 1962). Such studies may help us to understand some of the physiological mechanisms involved in critical periods in development.

To return to our previous theme, do the psychosomatic effects of infant stress upon subsequent growth and maturation apply to human as well as to rat infants? One cannot perform experiments on stress with human infants. There are, however, certain societies in which infants at different ages are subjected to certain stressful procedures, such as cutting or burning the skin to form a pattern of scars, piercing the lips or the ears, or molding certain soft bones by pressure. Landauer and Whiting (1964) have recently made a cross-cultural study of the

effects of such procedures on average adult height. They have found that there is a statistically reliable positive correlation between such procedures and mean height. The average superiority in height of the stressed group is more than two inches, and the data suggest that the first two years are the critical period for children.

Since this is a correlational study, they cannot be certain that there is a causal relationship. Nevertheless, the correlation remains when they analyze the data in such a way as to control for three factors likely to influence height:

namely, genetic stock, diet as indicated by protein, and sunshine, which presumably is related to growth-inducing vitamin D.

In short, clinical observations, behavioral experiments on animals, the results of biochemical assays and interventions, and cross-cultural comparisons are converging to show that there are critical periods in infancy during which certain events may have an especially great effect on subsequent physical and behavioral development. The phenomena are real; they are significant; the next step is to discover more about the laws governing them.

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THE CONCEPT OF EGO DEVELOPMENT

The term *ego development* has been used in a variety of ways. In child psychology it covers stages of observable growth in average, normal children and is tied to age-specific problems such as entry into kindergarten, adolescence, courtship, and so on. This usage makes the unwarranted assumption that everyone the same age is at about the same ego stage.

Two other usages occur, particularly among psychoanalysts. The term is sometimes used to cover only the period of the formation of the ego, not the later transformations of it. There are two objections to this usage. In the earliest period of ego formation, the problems of ego development are inseparable from other kinds of development because of the undifferentiated nature of the baby. Secondly, this leaves us with no useful term to cover later ego changes.

The third usage can only be understood in terms of a bit of history. As a legacy of nineteenth century mechanistic determinism, several schools of psychology have sought the ultimate determinants of all behavior in biological drives, presumably physiological tissue needs.

Freud frequently paid homage to this biological view. It was primarily on this issue that his split with Alfred Adler occurred, Adler insisting that the drives always act upon and through a person, at least in nonpsychotic people beyond infancy and early childhood. Current work on ego development can be thought of as directly descendant from Adler's insistence on the primacy of the whole person—in our terms, the primacy of the ego rather than of biological drives. (*Ego* is of course not quite synonymous with whole person or with the self, *self* being another closely related term. I prefer not to define the term ego but to let the reader begin with whatever understanding he already has and learn from context how the term is used here. In any case, the argument does not depend on fine terminological distinctions.)

Freud rejected Adler's views as a return to superficial psychology, a retreat from the insights into the depths of the unconscious and into psychosexual development that had provided the impetus of his early work. In the 1920's Freud came back to constructing an ego psychology and was impressed with the predominance, or, more exactly, the organizing function of the ego. There remain two schools of thought concerning the ego, within psy-

This essay is condensed from "The meaning and measurement of ego development," *American Psychologist*, 1966, 21, 195-206. Used by permission.

choanalysis and also among nonpsychoanalytic psychologists. On the one hand there is stress on the predominance and organizing function of the ego, on the other hand, not a belittling of the importance of the ego, but more often a view that ego functions are subordinate in the sense that they are somehow derived from the biological drives.

Since the death of Freud all psychoanalysts have stressed the importance of the ego. Among those for whom psychoanalysis remains primarily a theory based on drives as the fundamental concepts, Heinz Hartmann's term, *conflict-free ego sphere*, has become popular. This term refers to intelligence, perception, and motility—ego functions that normally develop with minimal distortion by conflicts originating in drives. *The conflict-free ego sphere, important as it is, is not the sphere of ego development.* Ego development, if it is to be a meaningful term, must be conceived in the first instance independently of drives and their derivatives, but it is nonetheless marked by its own distinctive conflicts.

In the present essay, the term *ego development* is an abstraction and a dimension of individual differences, like intelligence. The continuum referred to here resembles those that others have described in terms of moral character (Peck and Havighurst, 1960), moral judgment (Piaget, 1932; Kohlberg, 1964), capacity for interpersonal relations (Sullivan, Grant, and Grant, 1957; Isaacs, 1956; Isaacs and Haggard, 1965), cognitive complexity (Harvey, Hunt, and Schroder, 1961), and psychological mindedness (Murray, 1938). Actually, ego development includes all of these aspects.

Measurement of Development

Human development can be divided into four main streams or channels: physical, psychosexual, ego, and intellectual development. (As a first approximation, psychosexual development can be translated as development of drives and drive derivatives.) That division is not a particularly logical one: Cognitive elements enter ego as well as intellectual development, and both ego development and psychosexual development determine motivation.

The division into four streams has been arrived at in trying to follow the principle that Egon Brunswik (1951) adapted from Spinoza: Let the order of ideas be the same as the order of things.

Measurement of general intellectual level is one of the great achievements of psychology. Four aspects are relevant here. First, Binet broke with his predecessors by noting that some functions that require intelligence for their exercise do not provide useful measures of intellectual development. Second, although Binet provided several pointing definitions of intelligence, he relied mainly on the meaning in the common domain—on tacit understanding of what intelligence is. Thus, instead of guiding his work by a formal definition of intelligence, Binet only indicated the kinds of things included within its domain, then refined his selection by successive approximations. Third, Binet used development as touchstone for dimension, always based on prior inclusions and exclusions of functions in the intellectual realm based on his tacit understanding. Fourth, by developing an age scale he laid the path for Terman and others, who showed that adult status can be predicted using current status together with age.

The first three points apply to the notion of ego development advanced here. First, ego development is not the same as development of all functions exercised by the ego, and in particular intellectual development is not a fair measure of ego development, even though exercise of intelligence is an ego function.

Second, I propose to make no formal definition of ego development. Rather, there is a pointing definition embodied in this essay taken, as was Binet's definition of intelligence, partly from the common domain, partly from other writers. This definition, like Binet's, has already been corrected and is further correctable by experience from many sources.

Third, following Binet, development is used as touchstone for dimension, i. e., the term *ego development* is reserved for just what is common to a certain developmental sequence and a certain characterology that applies almost independently of age level. What is common to the developmental sequence and the characterology is an abstraction. To this abstraction and only

to this is the term *ego development* most appropriately applied.

The suggestion that the term *ego development* should be applied to an abstraction rather than to the concrete stages of growth observable in average children will seem strange at first, even though we are used to it in the concept of mental age. But all aspects of growth are occurring simultaneously; therefore, some criterion other than the normal sequence is needed to distinguish physical growth from intellectual, or intellectual from ego, and so on. Most accounts of ego development, those in child psychology texts as well as that of Erik Erikson (1950), tie the several stages to age-specific problems such as learning to walk and school experiences. But it is only when we have an account free of age-specific contingencies that we can ask such questions as: What is the typical age for a given ego transition? The optimal age? The earliest and latest possible ages? What conditions other than mere age are essential or favorable for each transition? These are not trivial questions, for gifted observers have located the first appearance of true guilt as early as the preschool period and as late as prepuberty; Erikson (1950) and H. S. Sullivan (1953) differ markedly in the age to which they assign the crisis of intimacy; and so on. Such observers are unlikely to be completely wrong; rather, they are looking at different people or at different aspects of a phenomenon with a given name. If we are to measure, or to contribute at all to psychology as a science, we must be somewhat abstract—and that entails seeking those aspects not age specific.

Ruling out age-specific aspects is related to excluding age-contingent scores. A given response is scored the same regardless of the respondent's age. The *interpretation* of a raw score depends on age, but age is never taken into account in deciding whether a response is right or wrong. This rule, adhered to in all intelligence tests, carries over to work on ego level.

Contrary to what one might think at first glance, the whole idea of an age scale breaks down if one allows age-specific contingencies to enter. The mental age (MA) scale is a measuring instrument appropriate to all ages just because it relies on those indices of mental devel-

opment whose appearance depends on where one is in the sequence of mental development, independent of chronological age (CA). The differences between a three-year-old whose MA is five and a ten-year-old whose MA is five are great, but these differences are just what MA is not. Before Binet, one could diagnose the difference between bright and dull three-year-olds on the basis of criteria appropriate to their CA, and the same for older children. The MA scale represented a scientific achievement just because it transcended such age-specific tests. Piaget in his microanalysis of mental development seems also to be trying to transcend age-specific aspects, but American readers, with their normative bias, often fail to see that Piaget is not setting norms for different ages but rather using average age differences as a device for tracing developmental sequence. The representativeness of his samples is not a major concern; he need only have comparable samples at different ages. Binet also used age as a device for tracing developmental sequence, though of course he was interested in norms.

The final characteristic of the Binet-Terman approach, the use of present status and age to predict final adult status, is not as yet applicable to ego level. There is no generally agreed-on age scale, though perhaps one could be evolved; certainly there is as yet no reason to believe that current status can be corrected by means of CA to provide a good estimate of final adult status.

Ego development must be distinguished, then, on the one side from intellectual development and on the other from psychosexual development, whatever may be the correlations between them. But the most difficult distinction to make is that between ego level and adjustment. In the early days of personality measurement it was assumed, in effect if not consciously, that adjustment is the same as conformity, and in particular as tendency to describe oneself in socially acceptable terms. The tendency to describe oneself in socially desirable terms is a conspicuous aspect of one stage of ego development, the one characterized predominantly by conformity. To be at the conformist stage neither precludes nor insures good adjustment. Our world is a conformist's world, as perhaps any must be, and many conformists are happy in it; they are not, however, immune

either to the most serious mental disturbances or to milder maladjustments.

Recently there has been a reaction among psychologists against the tendency to label conformity as good adjustment. Now it is maturity that is used as synonymous with good adjustment, regularly in clinical small talk, often in technical psychological writing, and even in common speech. Rarely will anyone refer to a college student as maladjusted any more. One simply calls him immature. This conceptual confusion is fatal to scientific clarity. There are certainly well-adjusted and poorly-adjusted children of all ages. Hence adjustment and maturity cannot be the same thing. A clear distinction between developmental variables and adjustment is essential to deepening our understanding of optimal conditions for development.

To distinguish ego level from intellectual level, from psychosexual level, and from adjustment is to ask for a clear conceptual distinction without in any way prejudicing the question of

correlations or of complex triggering or facilitating effects. The latter can be ascertained only after a conceptual distinction has been attained. Consider for comparison height and weight. Certainly they are not independently variable; they influence each other in one way and another; yet conceptually they are entirely distinct. While an estimate of one may be influenced by the other, careful measurement will not be. This is the kind of conceptual clarification needed in the area of ego development.

Stages of Ego Development

Having noted some of the things that ego level is not, let us turn to what it is. This will be done by pointing to and briefly characterizing the successive stages, as in the table. *

In the first stage of the ego the problem is to distinguish self from nonself. This stage can be

SOME MILESTONES OF EGO DEVELOPMENT

Stage	Impulse control and character development	Interpersonal style	Conscious preoccupation
Presocial Symbiotic		Autistic Symbiotic	Self vs. nonself
Impulse ridden	Impulse ridden, fear of retaliation	Exploitive, dependent	Bodily feelings, especially sexual and aggressive
Opportunistic	Expedient, fear of being caught	Exploitive, manipulative, zero-sum game	Advantage, control
Conformist	Conformity to external rules, shame	Reciprocal, superficial	Things, appearance, reputation
Conscientious	Internalized rules, guilt	Intensive, responsible	Differentiated inner feelings, achievements, traits
Autonomous	Coping with inner conflict, toleration of differences	Intensive, concern for autonomy	Ditto, role conceptualization, development, self-fulfillment
Integrated	Reconciling inner conflicts, renunciation of unattainable	Ditto, cherishing of individuality	Ditto, identity

divided into the *presocial* and the *symbiotic* stages. In the presocial or autistic stage animate and inanimate parts of the environment are not distinguished. In the symbiotic stage the child has a strong relation to his mother (or surrogate) and is able to distinguish mother from environment, but self is not clearly distinguished from mother. The ego can hardly be said to exist prior to the end of this stage. Language is an important, perhaps the crucial, factor in bringing this period to an end; thus the earliest period is hardly accessible to those studying the ego by means of verbal tests.

This first period alone is sometimes referred to as the period of ego development, meaning the period of coming into existence of the ego. That usage obscures the distinctiveness of ego development, for at this period ego development is virtually indistinguishable from intellectual and psychosexual development. To confine the term ego development to this era is to rob it both of meaning and of usefulness.

The second stage is the impulsive one; the child confirms his existence as separate from mother by exercise of his own will. Control of impulse is lacking or at best undependable. Rules are not recognized as such; an action is bad because it is punished. Interpersonal relations are exploitive and dependent, but the dependence is not recognized as such. People are seen as sources of supply. Conscious concern with sexual and aggressive drives is pathognomonic (i. e., telltale signs) for this stage.

Some manifestations of this stage remain remarkably the same throughout the life span, hence are not age specific, e. g., temper tantrums. More typically, preoccupation with bodily functions assumes a different form at different ages. The three-year-old makes joking remarks about "going pooh-pooh," while the adolescent who has not progressed beyond this stage shows not only that he is preoccupied with sex but that for him it is a bodily function exclusively rather than a social relation. The latter signs are more or less age specific. They are necessarily used in diagnosis but must not be used to define the continuum, lest we lose sight of the abstract quality that describes both the (normally) impulse-ridden small child and the

(developmentally retarded) impulse-ridden adolescent or adult.

The third stage is the opportunistic one. It is understood that there are rules, but they are obeyed in terms of immediate advantage. Thus, the morality is purely an expedient one. What is bad is to be caught. Interpersonal relations are manipulative and exploitive, but there is a marked shift away from dependence. The small child says, "Do it by self," and the adolescent at this stage says, "Who needs them?" Conscious preoccupation is with control and advantage, domination, deception, getting the better of, and so on. Life is a zero-sum game; what you win, I lose.

The fourth stage is the conformist one; more people have recognized and described this stage than any other. At this stage the rules are partially internalized. They are obeyed just because they are the rules. Chief sanction for transgression is shame, in contrast to the opportunistic stage preceding, which is often described by others (but not by those in it) as shameless. Genuine interpersonal reciprocity is possible now; reciprocity is, after all, the Golden Rule. In many cases, however, the mutual trust is extended only to a narrowly conceived ingroup. There may be strong prejudice against various outgroups conceived in stereotyped terms. Interpersonal relations are seen primarily in terms of actions rather than of feelings and motives. Conscious preoccupation is with material things, with reputation and status, with appearance, and with adjustment. References to inner feelings are typically stereotyped, banal, and often moralistic. The transition from the conformist to the next level is often if not always marked by introspection and self-consciousness.

The fifth stage we call the conscientious stage. Morality has been internalized. Inner moral imperatives take precedence over group-sanctioned rules. The sanction for transgression is guilt. Interpersonal relations are seen in terms of feelings and traits rather than actions; they become more vivid, intensive, and meaningful than in earlier periods. Conscious preoccupation is with obligations, ideals, traits, and achievement as measured by inner standards rather than by recognition alone. Conduct is seen not simply as a series of actions, but as a set of enduring propensities; spontaneous inter-

est in the origins of their conduct is often expressed by unsophisticated subjects at this stage. Capacity for self-criticism characterizes this stage, its absence the conformist stage. Self-criticism may, indeed, mediate the transition, though that topic is beyond the scope of the present effort at definition. Conformists as a group tend to see themselves in socially acceptable terms, though they may also report accurately specific symptoms, which are usually socially disapproved; conscientious persons, or at least some of them, tend to view themselves hypercritically.

The next stage we call the autonomous one. Impulse control is usually not a major problem at this late stage of maturity. The characteristic moral issue is coping with inner conflict, conflicting duties, conflicting needs, conflict between needs and duties, and so on. Such conflicts, although quite evidently present at earlier periods, including the conscientious one, are not squarely and consciously coped with earlier. Along with coping with one's own conflicts comes greater toleration for those choosing other solutions than one's own, in contrast to the moral condemnation frequent in conscientious and conformist stages. Interpersonal relations remain intense, they involve a recognition of inevitable mutual interdependence, and, a crucial addition, they involve the recognition of other people's need for autonomy. Thus a typical conscientious mother feels obliged to prevent her children from making mistakes, whereas a typical autonomous mother recognizes their need to be allowed to learn from their own mistakes. Conscious preoccupations especially characteristic of individuals at this stage of ego development are role differentiation, individuality, and self-fulfillment.

At the highest stage, which we call integrated, the person proceeds beyond coping with conflict to reconciliation of conflicting demands, and, where necessary, renunciation of the unattainable, beyond toleration to the cherishing of individual differences, beyond role differentiation to the achievement of a sense of integrated identity. In normal groups such persons rarely appear, so new insights are hard to confirm. Maslow (1954, 1962) has sought out and studied a number of such persons, and on this empirical though not rigidly controlled ba-

sis has described the stage more extensively [see p. 126].

Probably it is a mistake to idealize any stage. Every stage has its weaknesses, its problems, and its paradoxes, which provide both a potential for maladjustment and a potential for growth. One problem of the autonomous stage is how to reconcile the need for autonomy with dependence needs, on the one hand, and with exercise of authority on the other. Another paradox is the paradox of responsibility. Piaget (1932) notes that young children (hence, children at low ego levels) consider more blameworthy breaking fifteen cups by accident than breaking one cup while stealing jam. Older children (hence, on the average, of higher ego level) assign blame in accord with motives rather than consequences; so breaking one cup while stealing is the worse offense. But at the highest ego levels, which Piaget did not study, one acknowledges responsibility not only for one's motives but also for the consequences of one's actions. Indeed, one is not completely responsible for one's motives nor completely absolved of responsibility for the consequences of actions taken from good motives. To see such unresolved problems is important, lest one mistakenly assume that the person highest on the scale of ego maturity will necessarily always turn out to be the best parent or teacher or therapist.

For each stage one can specify the characteristic mode of impulse control and character development, of interpersonal relations, and of conscious preoccupation, including self-concept. The assertion that these are all aspects of ego development would seem at first to be clearly testable. One need merely devise separate measures of impulse control and character development, of interpersonal relations, and of conscious content, then correlate. The more deeply one becomes involved in this area, the more it appears that impulse control, character development, interpersonal relations, and conscious preoccupations are indeed aspects of a single thing, so intimately intertwined that one can hardly define them separately, much less get separate measures of them all. Thus we find ourselves driven to a paradox: the assertion that they are all aspects of ego development is too true to be proved.

EXPERIMENTAL MODIFICATION OF MEMORY STORAGE

Memory is one of the most intriguing as well as important capacities possessed by man and the other animals. Almost everything that we do requires memory. As is the case of all things that we use often, our ability to store memories and to use them when needed is so taken for granted that we typically think about memory only when someone's memory fails to work "properly."

Imagine, if you can, a person with complete loss of memory. The behavior of such a person would no doubt be quite bizarre. Complete amnesia probably occurs only when a person is in a coma. We are all familiar, however, with reports of cases of partial amnesia. One type of partial amnesia involves memory for recent events. After brain injuries, for example, there may be a specific loss of memory for everything that occurred a few minutes or hours before the injury, with older memories not affected at all. With severe injury, the period covered by such amnesia may be much longer—perhaps months or even years prior to the injury. This type of memory loss is termed *retrograde amnesia*.

Under other conditions, individuals lose the ability to acquire and retain new information while retaining the ability to recall older memories. This type of memory loss is often found in elderly persons, in patients with brain damage caused by disease or chronic nutritional deficiencies, and in patients who have had their temporal lobes surgically removed.

What do we know about brain processes underlying memory which can explain these memory pathologies? Unfortunately, very little is yet known about how the cells of the brain work to provide for the storage and retrieval of traces produced by experiences. We might turn the question around and ask, "Can we use knowledge gained from alterations in memory functions to increase our understanding of memory processes?" The clinical findings just cited do in fact contribute to our understanding of memory. In considering memory losses observed in human patients it seems necessary, for

example, to distinguish between recent memory and older memory because the clinical observations strongly suggest that the processes underlying the two are different.

Experimental Studies of Retrograde Amnesia

The usefulness of clinical data of the kind just cited is somewhat limited. The investigator can only examine "what nature has wrought" and attempt to make some interpretation of the basis of the effects. It would clearly be an advantage to have experimental control over the conditions producing the memory loss. For this reason, laboratory animals are used extensively in experimental investigations of memory processes.

The hypothesis that memory storage involves more than one process is particularly interesting because it suggests that it might be possible to gain an understanding of the bases of memory storage by studying the processes involved in the fixation or consolidation of durable memory traces. This general hypothesis has stimulated and guided a considerable amount of research largely with animal subjects. Of the many procedures used, most have involved the use of treatments designed to interfere with memory storage processes. Such research is based on the assumption that knowledge of the ways in which various specific experimental treatments impair memory storage will lead ultimately to an understanding of how memories are stored.

In experimental animals, older memories have generally been found to survive a variety of treatments including cooling of the brain, electroconvulsive shock (ECS), and administration of drugs. Although such treatments may severely affect the animal's performance, his ability to perform well-learned responses generally recovers soon after the treatments are discontinued. That is, treatments temporarily impair performance but evidently do not disturb

the "engram" or permanent memory trace.

The traces of recent experiences, however, are considerably more fragile. Treatments such as electroconvulsive shock or certain drugs can cause forgetting of newly learned responses—that is, can produce retrograde amnesia—if the treatments are administered within a few minutes or hours after training. In one of the earliest published studies of experimentally produced retrograde amnesia, Duncan (1949) reported that the rate at which rats learned to avoid a punishing foot shock by moving from one end of a box to another was impaired if ECS was administered within an hour after each daily training trial. No impairment was found if ECS treatments were administered at intervals greater than one hour following each trial. This observation has subsequently been confirmed and extended by investigators in many laboratories (McGaugh and Petrinovich, 1966). The effectiveness of ECS administered at various intervals following training is now known to depend upon numerous factors, including the age, strain, and species of the animals used as subjects, as well as the training task and the specific procedures used. We have found, for example, that the degree of amnesia produced by ECS depends also upon the amount and duration of the electroshock stimulation.

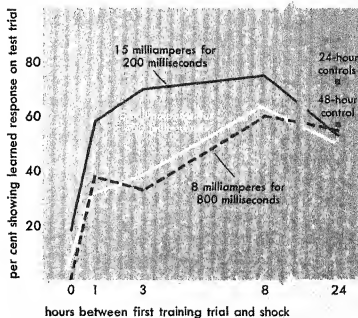
In one study mice were given a single trial on a simple avoidance task and were then given an ECS at one of several intervals within the next few hours. A retention test was given the next day. On this test, retention, as measured by the percentage of subjects in each group who demonstrated the learned avoidance response, varied with the time of administration of ECS, as well as with the amount and duration of the ECS stimulation. ²² Greatest amnesia was found with the 800 millisecond treatment. Fifteen milliamperes for 200 milliseconds produced less interference than only half as much current for 800 milliseconds.

How does ECS produce retrograde amnesia? Although we do not yet know the answers to this question, recent findings have produced some promising leads. For example, findings from our laboratory indicate that the convulsion usually produced by electroshock stimulation does not contribute to the amnesia. Retro-

grade amnesia was produced by electroshock stimulation even when convulsions were prevented by lightly anesthetizing the animals with ether before applying the electric current to the animals' heads. This evidence clearly supports the hypothesis that the electroshock current produces retrograde amnesia by interfering with the storage or consolidation of long-term memory traces. Memory storage appears to require time. The studies varying the intervals between learning and ECS treatment indicate that the consolidation of long-term memory involves processes that under some circumstances may be in a state of flux for as long as two or three hours after training. Electroshock undoubtedly has many diverse effects on brain function. Consequently, discovery of the specific effects responsible for interference with memory storage will not be a simple task.

In general, the findings of experiments using other types of treatments have been similar to those of studies using ECS: all the treatments act selectively on recently acquired memory. If animals are deeply anesthetized with drugs like ether or pentobarbital sodium after being trained on a task, little evidence of retention is found when they are tested following recovery

EFFECTS OF ELECTROSHOCK ON MEMORY STORAGE



Based on McGaugh, 1966

from the anesthesia (Jarvik, 1964). The various drugs that have been tried are not equally effective as amnesic agents, however. Some drugs produce amnesia only when they are administered within a few minutes after training while others are effective when they are administered several hours after training. One drug, which produces convulsions rather than anesthesia, was found to affect memory when administered two days after training. It may be that this dramatic effect was due to a general disruption of brain functioning, rather than to a selective effect on memory storage processes.

The phenomenon of "spreading cortical depression" has provided a unique method for analysis of brain functions in memory storage. Potassium chloride, when applied directly to the cerebral cortex of a rat through a hole in the animal's skull produces a spreading depression of electrical activity which lasts for hours. Several studies have shown that storage of a learned response is impaired when such a treatment is administered after the learning trials. Because the depression of electrical activity is restricted to the cerebral cortex, these findings indicate that the cortex must be involved in memory storage.

Considered together, the results of studies using ECS, drugs, and spreading depression as techniques for producing impairment of new memories indicate quite clearly that severe disruption of brain activity interferes with the permanent storage of newly acquired memory. But the findings of these studies have not, as yet, provided an understanding of precisely how this interference takes place. We do not even know whether the effects of the various treatments have a common physiological basis or whether the common effect—retrograde amnesia—is produced by different mechanisms.

Recently, there has been a considerable amount of theoretical speculation (backed by a somewhat more modest amount of evidence) that memory storage may involve modification in the synthesis of ribonucleic acid (RNA) and proteins. It is possible, that is, that permanent memory is based on specific chemical changes in nerve cells and that retrograde amnesia is produced by the prevention of such biochemical modifications. According to this general hypothesis it should be possible to impair memo-

ry storage by administering drugs that are known to inhibit RNA and protein synthesis.

In recent work, however, injections of an RNA synthesis inhibitor actinomycin D, in amounts sufficient to produce nearly complete inhibition of brain RNA synthesis had no effect on learning or memory in mice. In these experiments, the animals were treated before training, and retention was retested between one and eight hours later. Performance was unimpaired over these retention intervals. Longer intervals could not be tested because of the extreme toxicity of the drug (Cohen and Barondes, 1966).

The results of studies using inhibitors of protein synthesis have been more promising. In one such study with goldfish, memory storage was impaired by injections of the protein synthesis inhibitor puromycin. Animals injected with puromycin behaved normally during training on an avoidance learning task, but retention was impaired on tests given several days later. Puromycin thus appeared to impair permanent memory storage without affecting short-term memory processes underlying the initial acquisition of the response. When puromycin was administered after training, impairing effects on retention were found only if the injections were given within an hour following the training. Thus its effects were highly similar to those found with ECS and drugs (Agranoff, Davis, and Brink, 1966).

Although it seems clear on the basis of these studies that memory consolidation is impaired by puromycin, it has not yet been demonstrated either that the impairment is due solely to protein synthesis inhibition or that protein synthesis inhibition is essential for impairment of memory consolidation. These problems are currently being investigated in many laboratories, and resolutions of some of these questions should be available in the near future.

Experimental Facilitation of Memory Storage

The finding that memory storage can be impaired experimentally suggested that it might also be possible to *facilitate* memory storage. This intriguing possibility has been investigated in a number of laboratories during the past few years. For the most part, such investigations

have involved the use of drugs known to stimulate the central nervous system.

In a study published fifty years ago, Karl Lashley (1917) found that the rate at which rats learned a maze was increased by the administration of small amounts of the stimulant drug *strychnine sulphate*. This finding was virtually ignored for many years, but recently it has been confirmed and extended by a number of investigators (McGaugh and Petrinovich, 1965). Facilitating effects have been obtained not only with maze learning but also with a variety of tasks and with other central nervous system stimulants as well as strychnine. In most of these experiments, however, the animals have been injected with strychnine each day several minutes before the training sessions were begun. Consequently, the animals have always been trained and tested while they were under the influence of the drug. When these procedures are used, it is difficult, if not impossible, to understand the way or ways in which the drug acts to influence the animals' performance. It may be that the enhancement is due to a stimulation of memory storage processes. It may also be that the enhanced performance is caused by other influences, such as enhanced motivation or alertness.

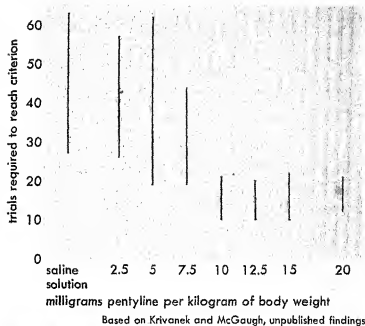
In recent experiments we have attempted to provide a clearer understanding of the basis of the enhancing effects of CNS stimulants. If the enhancement is due to direct effects of stimulant drugs on memory storage and if, as the findings discussed earlier indicated, memory storage processes continue for some time after training, then it should be possible to facilitate memory storage by administering these drugs *after* training. With post-trial injections, drug effects on memory can be studied without training or testing animals while they are drugged. Consequently, any effects found would seem most likely to be due to drug influences of memory storage processes.

In numerous recent experiments we, as well as other investigators, have obtained clear evidence that memory can be facilitated by post-trial injections of central nervous system stimulants. The facilitating effects have been found with a wide variety of training tasks and procedures and with several drugs. The degree of facilitation has been found to vary with a number

of conditions including the drug dosage used, the strain of animals tested, and the particular type of learning task.

In one recent study mice were given three training trials each day in a visual discrimination problem. The mice were hungry and thirsty and were rewarded with food each time they responded correctly. As each mouse completed the third trial each day, it was injected. Animals in different groups received different doses of the drug (pentyleneetetrazol) or a solution of physiological saline for control comparison. This was continued until each animal achieved a learning criterion of nine correct choices out of ten responses. As the figure clearly indicates, animals given post-trial injections of the drug learned the discrimination much sooner than did the controls. Learning scores also improved systematically with increases in the drug dosage.

In another experiment the same drug and training procedures were used but groups were given the injection at different intervals before or after the training trials. Facilitation was found with injections administered

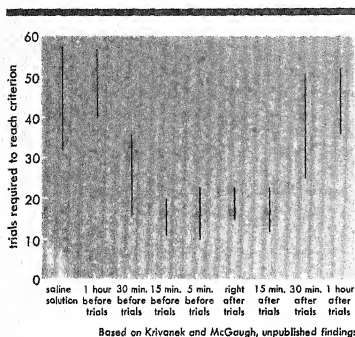


FACILITATION OF DISCRIMINATION LEARNING WITH POST-TRIAL DRUG INJECTIONS

The vertical lines show the range in the number of trials required by subjects receiving a given dosage; the small circles indicate the means. Twelve subjects are represented in each case.

EFFECTS OF TIMING OF INJECTIONS

The vertical lines show the range in the number of trials required by the subjects receiving injections at each of the times indicated; the small circles indicate the means. Six subjects are represented at each interval.



Based on Krivanek and McGaugh, unpublished findings

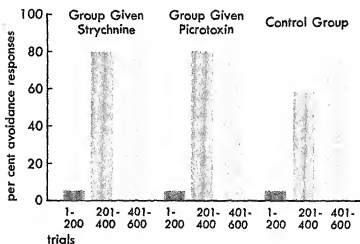
up to fifteen minutes after each day's training session. ♦ Similar results have been obtained with other drugs and with other training tasks.

Still another study compared the speed of learning of three groups of mice receiving immediate post-trial injections. Both groups given central nervous system stimulants (strychnine or picrotoxin) at the end of the first day's trials started their second day's trials at a higher level of proficiency than the control group and reached their top performance sooner. ▲ In this experiment, as in other similar ones, no effects were found if the injections were given one hour after the training on the first day.

These studies of the effects of central nervous system stimulants on learning and memory clearly indicate that learning can be enhanced by drugs. Further, the evidence from post-trial injection studies suggests that the drugs enhance learning by affecting processes involved in memory consolidation. But what processes are affected by the drugs? What spe-

cific mechanisms underlie the enhancing effects? Although the drugs investigated, in various compounds, are known to have many effects on the central nervous system, we do not completely understand the mechanisms underlying these effects. Until we know more about the mechanisms of these drugs, our speculations concerning their effects on memory storage are likely to be imprecise. These are clearly questions for future research.

As mentioned earlier, there has been considerable interest in the hypothesis that memory storage is based on modification of RNA. Although inhibition of RNA synthesis failed to affect learning or memory, as already cited, studies of the effect of drugs which enhance RNA synthesis have been somewhat more promising, and there is evidence that learning can be facilitated by administration of such drugs. In these experiments, as in so many of those involving stimulants, the drugs have been administered to the animals prior to training; consequently, the facilitation observed could be due to a variety of influences unrelated to memory storage (Plotnikoff, 1966). Additional research is needed before we can know just what is happening.



Based on Bovel, McGaugh, and Oliverio, 1966

▲ EFFECTS OF STRYCHNINE AND PICTROTOXIN ON AVOIDANCE LEARNING

Although all three groups ultimately reached almost the same level of learning, the groups given stimulants reached it considerably sooner.

The hypothesis that memory storage is based on modification of RNA has also been supported by the reports of some investigators that memory can be transferred from one animal to another by injecting a naïve animal with RNA extracted from a trained animal. However, as you have seen in Chapter 6, we, as well as numerous investigators, have been unsuccessful in attempts to obtain this type of "memory transfer." This is another problem for future research to resolve.

Implications and Prospects

It does seem, as clinical evidence suggests, that we must conceive of *at least* two memory mechanisms. A temporary process is needed to store experiences prior to the consolidation of long-term traces of the experiences. But how are the two kinds of traces related? Are short-term and long-term traces merely different stages of the same process? Or are short-term and long-term memory based on different and independent processes? This latter view suggests that on-going experiences trigger activity in both short-term and long-term processes simultaneously and that the short-term processes decay as the long-term traces become consoli-

dated. Although it is premature to decide among these and other alternatives, recent research findings provide some support for the view that short-term and long-term memory are independent processes.

The questions raised in this brief review are but a few of the questions that we will need to ask and answer before we will be prepared to obtain a complete understanding of memory. We will, of course, need to have a concise conception of memory storage as a system of processes involved in memory storage before we will be in a position to discover the physiological bases of these processes.

Although it is clear that interest in memory has surged dramatically in the last decade, interest in discovering the nature and basis of memory has stimulated intensive research in psychology and biology for many years. The research reviewed in this brief introduction represents but a small fraction of current theories, research techniques, and findings.

The problem of memory storage is both complex and challenging. Recent findings have contributed significantly to our theoretical conceptions of memory-storage processes. The current surge of theory and research suggests that we may soon begin to offer detailed answers to some important questions concerning the nature and bases of memory.

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HUMAN PERFORMANCE

The need to understand the limits of human performance or human capacity is something that has crept up on us in the last few decades almost without our being aware of it. We have become involved in manned space flight, seen the advent of 200-passenger commercial aircraft, and watched without apparent concern as the highways have filled with high-speed ma-

chines operated by indifferently trained drivers. All of this has occurred without any real understanding of how much demand these tasks and others like them place on humans.

Unfortunately there aren't very many "hard" facts about what men can and cannot do in very complex systems of men and machines. There is a wealth of information about isolated human functions—about vision and audition, for example. But extrapolation from data gathered under ideal laboratory conditions to opera-

This essay is a revision of an article of the same title appearing in *International Science and Technology*, July 1966, 58-68. Used by permission.

tional situations is a hazardous business that few engineering psychologists are willing to undertake. Our difficulties arise because in most of the important human functions in our technological civilization we perform as controllers, communicators, calculators, and decision makers.

The automobile and the task of driving will serve as an illustration. It is remarkable how easily and precisely even a mediocre driver can slip his car into a hole in a stream of moving traffic with only a few feet of clearance on either side. He does this at surprisingly high speeds; a timing error of only a few milliseconds would lead to a collision; yet usually there is no collision. How does he do this? We might attempt to describe it as an information-processing task; some "infopsychologists" see it this way. Or we could describe what the man is doing as if he were part of a linear servomechanism; and there are "servo-psychologists" who see man as a human tracking machine in such tasks, using feedback to compensate for the difference that exists between what is and what is desired.

But the driver is not really only an information-processing channel, and he is not really only part of a linear servomechanism. In either

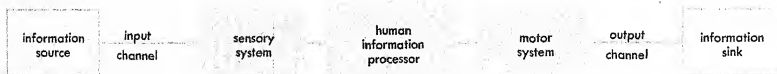
case, there are boundaries on performance, the sources of which are by no means obvious.

Some Performance Boundaries

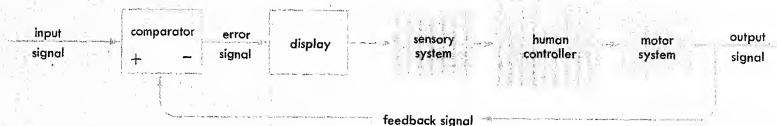
Let us take a look at some of the kinds of boundaries. One boundary arises from the interaction of system dynamics and human dynamics. The man part of a man-machine system has limits that are set by the musculature of the controlling limb, its mass, and its physical design. Thus it is possible to calculate some reasonable outer limits of control behavior which cannot be exceeded. The machine part of the man-machine system also has characteristics—its dynamics—which require certain control behavior from the man.

There probably are many systems which seemingly could be operated by man which are, in fact, far beyond his capacity. The deficiency comes from the "internal dynamics" of the man, not from those evident mechanical ones. Presumably the limit comes from some kind of time-consuming decision process which intervenes in the control process. The situation then looks like the sketch, where the relative sizes of the tubes are about right for a visual input and

TWO MODELS OF MAN

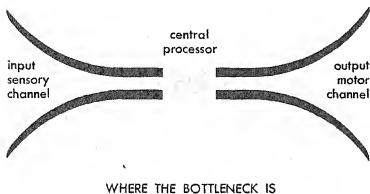


MODEL OF MAN AS AN INFORMATION TRANSMISSION SYSTEM



MODEL OF MAN AS A PART OF A FEEDBACK CONTROL SYSTEM

a manual output, each to its own limit. The eye can handle up to about 20 cycles per second of lateral excursion, and the hand can put out about 10 cycles per second. As a control system, the combination of eye, hand, and the human central processor is relatively ineffective beyond about 1 cycle per second.



If this seems a rather inefficient transformation by the central processor, consider the same system treated as if it were an information channel. Experiments involving the playing of random piano music and the typing of random letter groups show that the upper limit for human-information transmission could be as much as 50 bits per second (Quastler, 1956). The limits of the hand as an information output device that is *isolated*, in effect, from the central processor, have never been explicitly measured. However, given the relative precision of pointing and the speed of movement that can be achieved, we can estimate the limit to be about 100 bits per second.

The capacity of the eye is impressively higher. It has been calculated that the human eye, considered as an informational channel, can transmit to the optic nerve, even if not to the central processor, 4.3×10^6 bits per second (Jacobson, 1951).

The ear has a capacity about 1/430 as large: 10,000 bits per second (Jacobson, 1950). Yet at the limit, man transmits about 50 bits per second, and in most real tasks far less than that.

It is significant to compare the behavioral limit in control tasks with that in information transmission tasks. The 1-cps control system can transmit 2 bits per second or only 1/25 of the 50 bits of maximum transmission, yet there is no logical error in making the conversion

from control system bandwidth to bits per second—only perhaps a psychological error—since both are true limits, correctly arrived at. It is convenient to assume that, at the limit, the central processor is working at the same level of effort for *all* tasks, regardless of the measured level of performance, and that the differences in performance on various tasks are the effects of the ways information is presented to the man and accepted from him. Some of the differences are, of course, the result of the level of learning of various aspects of the task.

The Learning of Signal Characteristics

Suppose that a man has to control a system which is disturbed by a random signal, a task like driving a rutty road. If he does it for a while, he can learn a great deal about what kinds of things to expect—he learns the statistics of the signal and adjusts the statistics of his control behavior accordingly. If the same signal is repeated, he will eventually learn more and more of the detail and will begin to emit the appropriate control activity with less and less delay until at last he is doing the right thing at the right time with no delay.

Clearly, the original "poor" performance was not motor-limited, because, with repeated exposure to the signal, he tracks it better than he did before. It was not visually limited because he gets the same type of signal every time. The central processor must have been the thing responsible for the poor original performance.

The sequence of judgments and decisions in this processor becomes progressively more nearly automatic, thus reducing the demand placed on the man for any given level of performance.

The attitude of the human operator toward the task is also a vital factor. The driver following a friend to his home in the country for the first time has difficulty keeping up with what the leader feels to be a painfully slow pace; the follower is operating at far above a comfortable demand and the leader far below it.

Most real tasks are far more repetitive and learnable than their laboratory analogs that we use to investigate human performance. As a result psychologists probably overestimate the magnitude of the demand made on the man,

and engineers are frequently thus led to design him out of control systems. This latter practice results in his being little more than a monitor of system performance most of the time, with consequent serious implications for the safety of the entire system in the event of failure of the automatic part of the machine.

If an aircraft pilot is required merely to monitor the behavior of an automatic-landing system of fair reliability, he gets very little practice to keep him at the peak of his skill for use when that infrequent failure comes along and requires that he operate close to a performance boundary. It would probably be better if the pilot were never taken out of the control loop completely; he and his "mechanical copilot" should operate together. Perhaps he should not even know "who" is flying the aircraft, except by noting whether there is a gross disparity between his command signal and that of the autopilot.

The Question of Demand

Let us return to the notion of the "demand" placed on a human being by a task. Rather than using a host of engineering models to describe human behavior, thus generating a host of different limits, we would like to be able to say that one task places so much demand on the man while another task places some percentage more or less, even though one task may be piano playing at 50 bits per second and the other may be performing a controlled retrofire maneuver of a space capsule at about 5 bits per second. If both demand performance at the limit, then both place a 100 per cent demand on the man. The unlike ways in which the inputs and outputs are encoded for the man's use make the difference, when the two tasks are considered to be information transmission.

This is not to say that it would be better to present attitude information to an astronaut in musical notation and enable him to control his spacecraft through an 88-point keyboard. The nature of the piano-playing task permits a high information rate at the output, but the written music input doesn't change in response to what the pianist has just done, nor does it change of its own accord from time to time without warn-

ing. (Would that be an interesting kind of music?) As a consequence of those two characteristics, it is possible for the player to look at the notes ahead and organize streams of manual activity in advance of the moment when they are emitted by his fingers. Try to imagine the difficulty of playing a new piece when each note appeared to you just at the moment you played the preceding one. Such a task structure would forbid the anticipatory organization of output sequences to be emitted at the right time with no appreciable delays; your output rate would probably be from 2 to 5 bits per second.

Regardless of the task structure, the prime limiting effect of the human central processor seems to arise from the single-channel nature of attention. Except in very rare circumstances, and there is even some doubt about those, inputs are handled one at a time (Senders, 1965). This is obvious where signals are presented to the eyes and are located 180° apart. Less intuitive is the notion that, even if two things are in the same place, both cannot be attended to strictly simultaneously. And even harder to accept is the fact that you cannot listen to meaningful material and look at meaningful material and process both simultaneously at maximum rates.

Man As a Sampler

Man is a selective sampler of the constant stream of signals reaching his central processor from his senses. Selective attention can occur at many levels. Sometimes this selection apparently is initiated internally; very often it is caused externally. The selection process is complicated (Broadbent, 1958; Sanders, 1963).

Roughly, it appears that signals from many sources arrive at a short-term storage system and may get passed on if they are attended to. The attending may be overt and external, as in the fixing of the eyes on an object. It may be covert and external, as in attending to the color rather than to the shape of an object; some men are attracted by any redhead, svelte or not. Attention may be covert and internal, as in attending to a recently received signal even if new information is coming in.

Thus the attentional system is flexible, and

though it operates on only a single channel of information at one time, other signals are not lost forever because they were not attended to at the moment when they impinged on a sense organ. If there are many signals from many sources, how do they queue up for attention and wait their turns? It is clear that if a signal demands attention when no other signal is being attended to, it can be handled promptly; if one signal is being attended to, the second signal must wait. We can examine the way in which signal characteristics influence human behavior and see what this means when we put it into the notion of a queue. Senders (1955) experimented with the application of Shannon's sampling theorem: to human visual sampling. The sampling theorem sets forth a relationship between signal characteristics and the number of samples, equally spaced in time, which would permit you to reconstruct the signal with some arbitrarily small error. Simply put, if you look at something often enough, you can tell almost exactly what has gone on even between looks. The more rapidly the "something" changes, the more often must you look at it. This seems sensible enough as a description of human observers, and early experiments showed that, on the average, it predicted quite well what people did under well-defined laboratory conditions. The sampling theorem and extensions of it have not specified that they apply only to nonhuman samplers. The relationships are indifferent to the mechanisms. Thus we can use them to establish outer boundaries within which a human sampler must operate if he has the same goals of signal reconstruction, and then we can set different goals and get better estimates of these same boundaries.

In 1949, the Aero Medical Laboratory at Wright-Patterson AFB started a series of studies of how pilots look at their instruments while engaged in a variety of flight tasks (Jones, Milton, and Fitts, 1949). The point was to see if a better-than-standard instrument panel layout could be achieved—a layout which would require fewer and shorter eye movements and, presumably, permit easier instrument flight. There are some general comments about those experiments which are of interest here because they revealed that man is probably a conditional sampler.

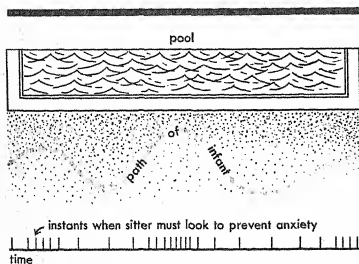
First, the intervals between a pilot's observations of any given instrument were distinctly nonregular, and the distributions of intervals were nonsymmetrical; the durations of observations were also variable but far less so than the intervals. Second, the switching of visual attention from instrument to instrument was not characterized by fixed scanning patterns but could be described only in statistical terms. Furthermore, the durations, intervals, and switching statistics were different for different pilots and all of these varied with the particular flight problems a pilot was attempting to perform.

In aircraft and in laboratory experiments, the human observers were not really trying to put the signal back together again, which is the situation discussed in sampling theory. Information which has gone by is of little importance; what is actually happening and what may happen are of great importance. If a pilot is interested in detecting things whenever they are at the "red line," then his sampling behavior will be aperiodic and the intersample intervals will be distributed as were those of the subjects in both the in-flight and laboratory studies.

In homely terms, consider the problem of trying to read a book while baby-sitting at the edge of a swimming pool, with a baby crawling around on the grass. If you look at the baby you will observe where he is, what direction he is pointing in, and (if you are an experienced sitter) you will have some idea of how fast he can move. If on the last observation you found him to be close to the pool and headed toward it, you would look again rather soon. If you had found him a good ten seconds' crawl away from the pool and headed away from it, you could get a good part of a page read before you would feel compelled to look again.

If now we were to plot the distance and direction of the baby as a function of time—a "random crawl"—it would look rather like the figure, and your observations would be like the lines marked on the plot: irregular, more dense near the pool edge, and sensitive to the instantaneous direction and speed. There would be more observations than you would have made if you had behaved in accord with the sampling theorem—because you would have been interested in preventing total immersion rather than

VARIABLE SAMPLING BEHAVIOR



merely in knowing whether it happened.

So one can be wrong in applying a simple engineering model to a man; we must refine and generate models which are more appropriate for human operators. A major danger of the use of oversimplified models is that one will be led to look for improvement where it may not exist, or, alternatively, to underestimate the capacity of men to do what is required of them.

Underloading vs. Overloading

If, on the average, demands are made at a rate which is lower than the rate at which attention can be given, it would not be proper to describe the situation as an overload. Yet from time to time by chance alone, simultaneous demands may occur. Even so, as will be indicated shortly, it may be better to have occasional double demands than too few.

One point of view is that the central processor is *always* running at full speed if it is running at all. Serious underloading results in the man's finding other things to do with the left-over capacity. He may daydream or even doze, so as to lower the effective full-load capacity. Driving on a dull road for long periods often results in sleepiness, as does listening to a bore. You're more likely to pay attention (awake now?) when the task is very challenging, but the probability of missing important signals also may rise. Obviously, somewhere in between is best,

and the problem is to find out just where. Here again the queueing notion is helpful. One can choose a demand rate such that the frequency of simultaneous demand is somewhere around one per minute. Vigilance studies suggest that such a signal rate helps to maintain human performance on watch at a high level over long periods.

You may recall from your own experience how you expand or contract your perceptual field while your internal information processor continues to operate at its maximum capacity. There is, of course, the cocktail party effect: you've met somebody dull, so you expand your perception and sample other conversations impinging on your ears; you switch your attention mechanism among the continuous inputs you hear. Similarly, when you are driving along the road with friends chattering merrily in the back seat, you can listen and carry on a conversation with them until the traffic gets dense. Then the demands on your central processor grow until you need every bit of its capacity; you try to pay attention only to the inputs that affect your driving task. Usually these are visual and when you have reached a limit, the demands from the audible signals from the back seat become too much.

The demand on the attention mechanism also can be too low in the face of an unchanging external environment; a man tends to adapt to any steady stimulation. A light attracts attention, but if it stays on, it ceases to attract. If it blinks periodically, it attracts attention until you have learned the rhythm (which is why it is harder to ignore the random blinking of the highway-construction neon-discharge warning lamps).

A Caveat

Man cannot be taken from a handbook of data representing him as an idealized model; the terms we use to fit him to such a Procrustean bed often mean one thing in engineering and something not quite the same in psychology. There are many tasks in which man appears to perform both as a servo and as an information processor or in which he changes his behavior from one to the other through learning.

One works with human performance data

and with transformations of these data which are really models of the man. However, there are various levels of model; they have different degrees of utility. Engineering psychologists are still trying to develop a uniform measure of man's input-output functions that will characterize his performance from sensation through

thinking to resultant output. We still lack the mathematics to do this, and so most formal attempts at measurement still try to squeeze man to fit the model of a particular theory, rather than developing new mathematical models which are in accord with man as we really know him to be.

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INTERNATIONAL COOPERATION AND ATTITUDE CHANGE

There is considerable disagreement about the potential contributions of such activities as international exchanges, cooperative ventures, or the Peace Corps—whatever their intrinsic merits may be—to creating the conditions for peace. Proponents of such activities often argue that they increase international understanding and improve mutual attitudes. There is some evidence in support of this view, but it is by no means clear cut. But even if these activities invariably produced more favorable attitudes in the participants, is it reasonable to suppose that favorable attitudes developed through personal contact can overcome the realities of a conflict of interests? If conflicts between nations are based primarily on incompatible goals rather than on lack of understanding, can increased understanding contribute greatly to their resolution? This essay will suggest four ways in which contacts may in the long run affect the likelihood of war and will then examine what direct attitudinal changes may be expected from such contacts and what factors determine whether these changes will be in a favorable or an unfavorable direction.

How May Programs of Personal Contact Affect the Likelihood of War?

We can distinguish four types of effects that programs of international cooperation and ex-

change have which may, in turn, have an impact on the relations between two nations and the ways in which conflicts between them are resolved: (1) development of a network of relationships cutting across national boundaries; (2) reduction in the level of tension between the two nations; (3) increased commitment to an internationalist ideology; and (4) increased openness in attitudes toward the other nation, especially among key individuals in each nation.

1. The most important source of the political relevance of international exchange and cooperation, in my opinion, is its contribution to the development of human networks that cut across national boundaries. Participation in such activities, if they are successful, is likely to lead to the establishment of ongoing relationships around common professional concerns among individuals representing different nationalities. These relationships have functional significance for the individuals in being directly relevant to their own professional interests and to the effective performance of their professional roles. Thus, individuals and groups from different countries become committed to international cooperation not as an abstract value, but as a concrete vehicle for carrying out personally important activities and pursuing their immediate and long-range goals. They become involved in a network of interdependent individuals and groups without reference to national differences, and are likely to develop a sense of loyalty to it. What is crucial here is that this loyalty cuts across national lines; it need not be

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antagonistic to or competitive with national loyalty, but is simply independent of it.

Coser (1956) points out that modern pluralistic societies are themselves "sewn together" by the existence of multiple group affiliations of individuals, which "make for a multiplicity of conflicts crisscrossing society" (p. 79). Thus, for example, individuals who are members of antagonistic groups in the economic sphere may, at the same time, be members of the same religious group and thus stand together in a conflict with other religious groups. Because the lines of conflict between these multiple groups do not converge, deep cleavages along a single axis are prevented. In similar fashion, the development of *networks based on professional and other interests that cut across national boundaries* can contribute to the stability and integration of the international system. It would do so not by eliminating conflicts, but by counteracting tendencies toward complete polarization—toward subordinating all relationships to a single basic conflict along national lines.

Insofar as groupings that cut across national lines are important to individuals in the enactment of their various roles—in other words, insofar as individuals have become tied into a pattern of genuine interdependency—they will resist a definition of the international system along strictly national lines, in which national affiliations supersede and subsume all other affiliations. Moreover, they will have something at stake in maintaining the integrity of the international system, since its breakdown would also mean the breakdown of the cross-national networks in which they are involved. As more and more cross-cutting ties develop through international exchange and cooperation, such vested interest in a pluralistic and stable international system is likely to increase and ever stronger barriers to the breakdown of the system are likely to arise.

2. If two nations that are in conflict with each other are, at the same time, involved in exchanges and cooperative ventures, the level of tension that marks their overall relationship is likely to be reduced. They are more likely to engage in at least some interactions that are free of hostility and mutual threat, and that provide opportunities for communication and for the

discovery of common values and interests. Needless to say, these more positive interactions will not cause the basic conflict between the two nations to vanish and will not persuade them to abandon the pursuit of incompatible goals. Such contacts can, however, contribute to the creation of an *atmosphere in which these basic conflicts can be negotiated more effectively and political settlements can be achieved.*

It has been extremely difficult, for example, for the United States and the Soviet Union to negotiate disarmament agreements, even though such agreements would be beneficial to both sides, because of the absence of mutual trust. Negotiation of more basic settlements of Cold-War issues is even more difficult under these circumstances. Positive interactions between two nations in areas outside of those on which their conflict centers, by reducing the level of tension, may help to build up some degree of mutual trust and thus at least make it somewhat more likely that serious negotiations on the issues in conflict will get under way. Moreover, the establishment of cooperative relationships in some domains may help to counteract tendencies toward complete polarization of the conflicting nations and may thus make it easier to find ways of "fractionating" the conflicts between them. Fisher (1964) has argued very persuasively that fractionating conflict—"dividing up the issues and considering them separately in small units" (p. 109), rather than treating each as part of a total ideological confrontation—may reduce the risk of war and at the same time facilitate achievement of specific national goals.

3. International exchanges and cooperative ventures—provided they are intrinsically useful and satisfying—are likely to increase world-mindedness and commitment to an internationalist ideology among the participants. Wide adoption of this type of value framework would seem to be necessary to provide the ideological underpinnings to a peaceful world order. In the short run, peaceful settlement of conflicts is more likely where there is an acceptance of the legitimacy of supranational organizations and a willingness to surrender some degree of national sovereignty to them. In the long run, the stability and effectiveness of such supranational organizations will depend on the acceptance—

as fundamental values governing the relations between nations—of the concepts of international (in contrast to strictly national) security, nonviolence in the settlement of conflicts, and responsibility for human welfare on a worldwide basis. As the rate of international exchange and cooperation increases, it seems reasonable to suppose that ideological changes in these directions will become more widespread.

Such changes in the belief systems of individuals, in and of themselves, are not likely to produce major changes at the institutional level. New institutional arrangements develop only when their functional significance becomes widely apparent. Thus, for example, it can be argued that the major impetus for the development of the European Economic Community came, not from an ideological commitment to the idea of a united Europe, but from the recognition that economic operations can be made more efficient and profitable if they can be planned and coordinated with reference to a wider geographical area. Nevertheless, it is probably true that the existence of supporting beliefs within the societies—such as the belief in the idea of a united Europe and the postwar disenchantment with traditional nationalism in the case of EEC—facilitates the establishment of new institutional arrangements by providing an ideological framework ready to incorporate them. In the same sense, then, international exchange and cooperation may contribute to the development and strengthening of international political institutions by *increasing the ideological readiness for them among influential segments of the participating nations*, even though the major force toward the development of such institutions is likely to come from functional requirements rather than from an abstract commitment to an internationalist ideology.

4. Participants in international exchanges and other forms of cooperation do not universally and necessarily come away from these experiences with wholly favorable attitudes toward the other nation or nations involved. Yet the indications are that such experiences can and usually do produce some very important attitude changes—provided the experiences themselves are personally and professionally satisfying to the participants. Moreover, partici-

pants in such activities are likely to develop personal ties to the other country and to certain individuals within it, and thus a sense of personal involvement in its fate. Such increased understanding and involvement, though not likely to overcome real conflicts of interests that exist between the nations, can be expected to create a greater openness in individuals' attitudes toward the other nation. A continuing pattern of cooperation and exchange between two nations, involving many individuals who are in leading positions within their own societies, should then *create a greater predisposition within each nation to trust the other nation, to perceive it as nonthreatening, and to be responsive to it* (Pruitt, 1965). If conflicts arise between nations whose citizens have been having close and friendly contacts, there should be less of a tendency in each nation to perceive threatening intent in the other and to formulate the issue in black-and-white terms, and a greater readiness to communicate with one another and to seek accommodation.

What Changes Do Such Programs Produce?

The kinds of attitude changes that can be expected to result from participation in international exchanges and other cooperative activities are well illustrated by a study of the attitudes of a group of broadcasting specialists from sixteen different countries who spent four months in the United States. During this period they participated in various professional and academic seminars, they visited broadcasting facilities, and they traveled through various parts of the country. A variety of procedures were used to evaluate the effectiveness of this program. One of these consisted in a detailed questionnaire, completed by the participants shortly *before* they arrived in the United States and again about nine months to a year *after* they had returned home. In order to be confident that changes from the before- to the after-questionnaires can indeed be ascribed to participation in the exchange program, we also questioned a control group of nonparticipants from the same countries as the participants, with comparable status and experience, who filled out the two questionnaires at the same

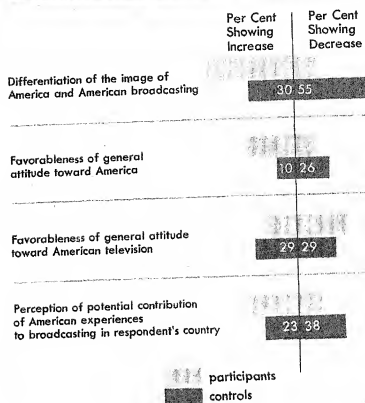
times as the participants, but who did not come to the United States during the period in between.

From past studies, we knew that there is no particular reason to expect an increase in overall favorableness toward the United States as a result of such a visit, even under the best of circumstances. Those who start out with negative attitudes may find confirming evidence for them; those who start out with positive attitudes may have little room for change in the favorable direction; and those who start out with neutral attitudes may find things they like balanced by things they dislike. Thus, marked changes on the dimension of favorableness do not represent a realistic goal for international exchange programs—nor is the uncritical acceptance of all features of the host country even a desirable goal. An outcome that is both realistic and desirable, however, is the development of a fuller, richer, more detailed picture.

Thus our major interest was in assessing changes in cognitive structure—in particular, changes in the complexity and differentiation of our respondents' images of America and of American broadcasting. To this end, we developed an overall index of "differentiation," based on responses to a series of questions. As the figure shows, participation in the exchange program seemed to produce more complex, refined, and detailed attitudes toward America and American broadcasting even in this group of individuals whose level of information and sophistication was high to begin with.

Those who participated also showed a greater increase in favorable attitudes toward America than did controls. These changes, however, are far less dramatic than the changes in differentiation. The pattern of change in attitudes toward American broadcasting is also interesting. Participants, when compared to controls, actually became *less* favorable in their attitudes toward American television. On the other hand, they were more likely to conclude—after their visit—that American experience in broadcasting can potentially contribute to the development of broadcasting in their own countries. In responding differentially to the three evaluative measures, the participants in the exchange program gave additional evidence of increased differentiation in their attitudes.

▲ ATTITUDE CHANGE AMONG FOREIGN BROADCASTERS



After having observed American television in some detail, they tended to like it less, but at the same time they were more aware of valuable lessons that they could learn from it.

What Factors Facilitate or Inhibit Favorable Change?

We can turn now to a review of some of the conditions that make a stay in a foreign country conducive to the development of an openness to the other country, a readiness to accept it on its own terms, and an appreciation for at least some of its features. Such an experience does have great potential for producing favorable attitudes of that sort as well as for developing personal ties and a feeling of identification with the host country.

Social-psychological investigations of exchange students and personnel involved in foreign aid projects provide a number of hints about the variables determining the probability that favorable attitudes will develop. An important variable, for example, is the opportunity

the visitor has for genuine contact with nationals of the host country and for involvement in various aspects of its life. Another important and obvious factor is what happens in the course of the contact—what treatment the visitor receives at the hands of the host. Early studies on race relations, such as those by Allport and Kramer (1946), suggest that favorable changes (on the part of the host as well as the visitor) are most likely to take place if the contact is at an equal status. Finally, the more positive and rewarding the visitor's general experience has been, for whatever reason, the more likely he is to become positive toward the country and its people.

It is not enough, however, to consider variables that would facilitate change. It is also necessary to pay deliberate attention to the various barriers to favorable change. These barriers derive in part from the preconceptions and motivations of the visitors. A visitor who starts out with hostile attitudes toward the host country may confirm them by being selective in his perception and by avoiding or reinterpreting information that does not fit his preconceptions. Also, he is likely to minimize communication or handle his interactions in such a way that they will tend to confirm his unfavorable attitudes and expectations.

There are various circumstances under which a visitor will be especially motivated to avoid favorable information about the host country and to seek out negative features. A visitor who is sensitive about his national status, for example, and feels that his country is being downgraded, may defend himself against these feelings by rejecting the host country and accentuating its weaknesses. This seems to be a strong factor in the reaction of Indian students in America interviewed by Lambert and Bressler (1956). Sometimes a visitor may resist positive information in line with the demands of a reference group back home to whom he expects to report on his experiences—and who will be expecting an unfavorable report (Zimmermann and Bauer, 1956). Or a visitor who is not well established in his home situation and is tempted by opportunities in the host country may derogate that country as a way of coming to grips with his own ambivalences (Bailyn and Kelman, 1962).

Even in the absence of motivation toward negative attitudes, barriers to favorable change may derive from the individual's experiences in the host country. If his overall experience in the host country is for some reason frustrating or unsatisfying, perhaps because of his work situation or his living arrangements or social isolation, he will be less likely to be open to the favorable information about the host country to which he is also exposed. Or particular negative experiences may interfere with the visitor's ability to see the positive features of the host country, even though these are isolated experiences and the visitor has in general been treated with kindness and friendliness. This would be particularly true if unfortunate experiences occurred early in the stay and thus affected the visitor's whole strategy of interaction from the beginning. It would also be true if an experience touched on a particularly sensitive area—for example, if the visitor were confronted with an act of discrimination because of his color.

Even some of the deliberate attempts of the hosts to provide the visitor with positive experiences may have unintended boomerang effects because of the needs, the sensitivities, and the cultural background of the visitor. If his privacy is scrupulously respected, he may feel there is a lack of interest in him. If, on the other hand, an exaggerated interest in him is evinced, he may also be resentful: he may feel that he is being treated as a curiosity and that people are eager to hear about the quaint customs of his primitive country. As the Lambert and Bressler (1956) study suggests, people who are sensitive about their national status relative to the host country will be particularly resentful of any implication that they are being patronized.

Implications for attitude change in exchange programs. To make exchange programs fruitful, it is clear that ways must be found of providing the visitor with rewarding experiences and positive contacts, while at the same time taking account of the various barriers to change that may arise even under favorable conditions. The real challenge is to provide the visitor with attractive and engaging opportunities without interfering with his freedom to make independent choices and to organize his life and activities in line with his own needs. Two types of

opportunities seem especially well designed to do this: (1) opportunities for genuine involvement in an ongoing enterprise and (2) opportunities for interpersonal involvement with people in the host country.

1. In the professional or educational setting to which the visitor is attached, it is important that he become a full-fledged participant, integrally related to some aspect of its ongoing activities. Such involvement increases the likelihood that the experience will be rewarding, maximizes the opportunities for meaningful contacts with nationals of the host country—whether as individuals or as colleagues or as people with whom the visitor shares common interests and goals—and facilitates the formation of substantial and lasting ties via an important joint activity. Insofar as possible, he should be treated not as a visitor, who is in a special category and requires special attention, but as a regular member of the organization—albeit a temporary one—whose participation in its on-going activities is desired, needed, and even expected. Ignoring him and according him special treatment are both ways of classifying him as an outsider and thus losing out on the dynamic potential that is contained in an integral relationship to the host institution.

2. The formation of a personal relationship to nationals of the host country is often a very important part of the visitor's experience, providing rewarding interactions while he is there and often leading to the establishment of lasting ties. Such relationships, of course, cannot be planned, but it is possible to provide opportunities for person-to-person contact, for example, by inviting the visitor to meet a local family and to participate in some aspect of community life. As already suggested, however, hospitality programs of this sort are likely to backfire if they are patronizing, ritualistic, or impersonal. The visitor needs to sense a personal interest in him and needs to see that the host is enjoying the relationship and getting something out of it. He must be regarded as an individual—equal to his hosts, interesting to his hosts, valuable in his own right—who at the moment happens to be living in a foreign country, which partly determines his current interests and needs but certainly does not circumscribe them. Thus he should not be constantly confronted

with the request to speak about his own country or to express his opinions about the host country. In short, he should be treated as a person, not as a specimen. His special status can and should be a criterion for initiating the interaction, but it should not be the sum and substance of that interaction.

In sum, I am proposing that *the exchange experience is most likely to produce favorable attitudes if it provides new information about the host country in the context of a positive interaction with some of its people*. The visitor is engaged in some meaningful activity together with nationals of the host country; he is working on a joint problem in which both are involved; he is participating in the give-and-take of a warm, personal, and individualized relationship. He is not merely presented with some objective evidence that these are nice people, but he knows them from his own experience. The very fact that he has worked and lived with people in the host country—and found these experiences rewarding—mobilizes his own motivations to see the country in a favorable light.

Implications for attitude change in foreign aid projects. Other kinds of international cooperative activities, such as foreign aid projects, involve many of the same considerations as international exchange programs but also introduce special considerations that must be taken into account. A program in which personnel are sent into the developing country provides many opportunities for nationals of the two countries to work together on a joint problem, to accomplish things together, to get to know each other in the process. In this respect, foreign aid programs have the same potential for producing attitude change as any kind of program that provides for contact, especially around a common problem. Here, as in exchange programs, the probability that favorable attitudes will develop depends on the amount of genuine contact that takes place, on the extent to which the contact is at an equal status, on the way the representative of the other country conducts himself in the course of the contact, and on the opportunities for establishing a give-and-take relationship.

A special potential for favorable attitude change is inherent in the very existence of an

aid program in that people tend to like those who benefit them (Heider, 1958). On the other hand, being helped engenders ambivalences; thus the way in which help is given in a foreign aid project is all important in determining whether the resulting attitudes in the recipient country will be more favorable or less so.

Motivational factors such as those already discussed may create unfavorable preconceptions about the donor country, and the aid situation itself may enhance recipients' sensitivities in regard to their own status. The fact that nationals from the donor country have come to his country to give aid is concrete evidence, from the recipient's point of view, of his own inferior status. The situation has obvious implications of an unfavorable comparison, damaging to the recipient's self-esteem and conducive to the generation of hostility. Such hostility is most naturally directed at the one who, by giving, underlines the recipient's inferiority. Under these circumstances, the recipient will be motivated to deny the donor's "kindness," to interpret his aid as being based on ulterior motives, to be particularly attentive to any weaknesses and flaws in the program, and so on. The strength of these tendencies will depend, of course, on the extent to which the particular character of the aid program is such as to elicit inferiority feelings in the recipient. But we cannot minimize the possibility that such forces will arise—and even the possibility that the greater the actual "kindness" of the donor, the greater the hostility that is generated. This paradox is inherent in foreign aid projects, despite their potential for favorable attitude change.

The way in which the foreign aid personnel conduct themselves in the country in which they are stationed has a great bearing, of course, on the attitudes that develop. The favorable effect of a generous and useful aid project may be completely wiped out because of unfavorable impressions created by those who administer the project. The behavior of the personnel takes on particular significance, however, in view of the special sensitivities engendered by the aid situation. The national of the recipient country is likely to be particularly attentive to and resentful of anything that reminds him of his inferior status. There are many ways—direct and indirect, obvious and subtle—in which the

aid personnel can communicate such reminders through their own behavior: by living at a standard that is clearly higher than that of the local population, particularly if they are ostentatious about it; by showing a patronizing attitude toward the local population, comporting themselves as benefactors, or acting like an occupation force; and by failing to learn the local language, showing a lack of respect for the local institutions, ignoring the local customs, and "sticking together" in isolation from the rest of the community—in short, by behaving in a way that implies that the recipient country is not worthy of their attention. Given the forces toward rejecting the donor country that are inherent in the aid situation, it is understandable that this type of behavior on the part of the aid personnel will create barriers to the development of favorable attitudes and may even result in increased hostility.

The real challenge in this field is to find ways of giving aid that will *enhance* the recipient's status in the process. Recipients of an aid program that has this character are not likely to dismiss it as manipulative and based on ulterior motives. They are far more likely to interpret it as a genuine act of friendship, and to develop increasingly favorable attitudes toward the donor. In the light of this, if the full potential of foreign aid programs for favorable attitude change is to be realized, it seems crucial, in my view, that status-enhancing features be built into (1) the project itself and (2) extra-project relationships.

1. In selecting a focus for the aid program, it is important to look for a project that is fairly directly related to people's immediate needs—that represents a way of dealing with a problem they face all the time and recognize; a project that can be executed fairly simply and that is likely to have fairly immediate results; and a project of such a nature that it can soon be taken over by the recipients, given their skills and facilities. In carrying out this project, the donors should make every effort to use the recipients' special knowledge, experience, and skills and at the same time, should be training local people so that as soon as possible they will be able to handle the whole project by themselves.

- A project selected and carried out in this way demonstrates to the recipient that he is held in

high esteem and actually serves to raise his status in a visible way—now he can do something that he could not do before, and he can continue to do it without further help; he has become more skilled and less dependent in the process. Contrast this to a large-scale, highly specialized project which leaves the recipient physically better off but does not make him "better" as a person in any way. Such large-scale projects can be very useful from the point of view of attitude change at a later stage, when the local population has become more aware of their importance and has developed enough skills to be able to participate in their execution. The initial projects, however, should be so selected that they make a visible difference in the individual recipient's immediate life and provide the opportunity for status-enhancing interactions. Under these circumstances, the recipient will be open to favorable information about the donor—and, of course, such information will be forthcoming to the extent that the donor communicates a genuine interest in the recipient and regards him as a full equal.

2. While the donor-recipient relationships in the project itself are essential in determining the effectiveness of the program, the extraproject relationships between donor and recipient are also of great importance. The selection, training, and preparation of the people sent abroad are, of course, major determinants of the kinds of relationships that become possible. Aid personnel should be prepared to live simply, to live as equals of their counterparts in the local population and in direct contact with them—a requirement that has been built into the Peace Corps program. They should learn the language and customs of the country and develop some appreciation for what the country has to offer. That is, they should not only "know" the customs, so as to avoid offending the local population, but have a genuine interest in the local culture. Under these conditions, it will be possible for the local population to regard the aid personnel as people like themselves, as people who respect them and are interested in them—rather than people who consider themselves superior and are interested only in exploiting the local population for their own advantage. In short, the ingredients will be present for a relationship that will enhance the

status and the self-esteem of the recipients.

It is of special importance to this relationship that the recipients have the opportunity to give something to the donors, to reciprocate for the help that they are receiving. This may be, for example, by feeding the aid personnel, by entertaining them in their homes, by inviting them to their festivals and celebrations, by introducing them to various aspects of their own culture. These acts of giving will, of course, be meaningful only if the aid personnel have communicated a genuine interest in *taking* what is being offered—if they have given some indication that they would regard an invitation as a special treat, that they are really interested in learning about the local culture, and so on. And it is not enough merely to pretend that such an interest exists. This desideratum underlines the importance of one aspect of the selection and preparation of aid personnel that is often neglected. In addition to arousing the man's desire to help the receiving country, it is also necessary to arouse his real interest in what the country has to offer him.

Thus whatever the particular situation, favorable attitude change can be expected from international contacts only when new information is supplied in the context of positive personal interactions. In such an interaction, there is more good to see and both participants are more open to perceiving it. In addition, the individual's own friendly behavior toward nationals of the other country becomes an element that enters into his definition of that country and ultimately into his evaluation of it. When, in the context of friendly action, he is exposed to new information that calls for a restructuring of his attitude, he will be considerably more receptive to it.

Engaging in friendly behavior toward nationals of another country thus creates a powerful potential for attitude change by producing the motivation and openness for examining and accepting favorable information. It is *the joint occurrence of friendly behavior toward the other and genuinely new information about him* that makes favorable attitude change possible. Insofar as international cooperative activities provide the occasion for such interactions, they help to create the conditions for a peaceful international system.

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 Amer. Psychologist—American Psychologist*
 Arch. Psychol.—Archives of Psychology
 Educ. psychol. Measmt.—Educational and Psychological Measurement
 Genet. Psychol. Monogr.—Genetic Psychology Monographs
 J. abnorm. Psychol.—Journal of Abnormal Psychology*
 J. abnorm. soc. Psychol.—Journal of Abnormal and Social Psychology*
 J. appl. Psychol.—Journal of Applied Psychology*
 J. clin. Psychol.—Journal of Clinical Psychology
 J. comp. physiol. Psychol.—Journal of Comparative and Physiological Psychology*
 J. comp. Psychol.—Journal of Comparative Psychology
 J. consult. Psychol.—Journal of Consulting Psychology*
 J. educ. Psychol.—Journal of Educational Psychology*
 J. educ. Res.—Journal of Educational Research
 J. exp. Anal. Behav.—Journal of the Experimental Analysis of Behavior
 J. exp. Psychol.—Journal of Experimental Psychology*
 J. gen. Psychol.—Journal of General Psychology
 J. genet. Psychol.—Journal of Genetic Psychology
 J. Pers.—Journal of Personality
 J. Pers. soc. Psychol.—Journal of Personality and Social Psychology*
 J. soc. Psychol.—Journal of Social Psychology
 Psychoanal. Psychoanal. Rev.—Psychoanalysis and Psychoanalytic Review
 Psychol. Bull.—Psychological Bulletin*
 Psychol. Monogr.—Psychological Monographs*
 Psychol. Rec.—Psychological Record
 Psychol. Rep.—Psychological Reports
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6 Defining and Measuring Learning and Retention

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7 The Management of Learning and Retention

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12 Emotion

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15 *The Individual and the Group*

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16 Communication and Persuasion

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Glossary

Listed below are many of the important terms used in *Psychology and Life*. The definitions given here are based on the usage of this book.

Absolute limen. Point at which a stimulus becomes strong enough to produce a response. Also called *threshold*. (257)

Absolute rating scale. A method of rating in which the judge assigns scores to each individual by comparing him to a standard independent of the group being rated. (144)

Absolute savings score. Difference between amount of practice required for original learning of a given task and the amount of practice required to relearn it. Sometimes savings are given as a percentage of the original learning score; this is the *relative savings score*. (210)

Absolutely refractory period. Period immediately following a nerve impulse, during which the nerve is incapable of responding to even very strong stimuli. (47)

Accommodation. Process by which the lens of the eye increases in thickness to focus on near objects and flattens for distant vision. (262)

Acetylcholine. Chemical substance that probably facilitates the passage of a nerve impulse from one neuron to another. (49)

Acromegaly. An overgrowth of certain portions of the skeleton (notably the hands, arms, jawbone, and chest), caused by an oversecretion of the pituitary growth hormone in adolescence or adulthood. (79)

ACTH. See *Corticotropin*.

Action potential. Activity in the nerve cell which can be measured; it is an electric potential change rather than a current. (48)

Action therapies. Therapies, usually based on learning theory, which seek primarily to eliminate symptoms and change behavior. Also called *behavior therapies*. (513) See also *Insight therapies*.

Adaptation. Adjustment of the receptors to stimulation or lack of stimulation. (258)

Additive color mixture. The mixing of lights, in which different wave lengths are added together. (272)

Adjustive behavior. Activities by which men or the lower animals attempt to meet the demands made upon them by biological and social needs. (39)

Adrenal androgens. Hormones secreted by the adrenal cortex which regulate the development of secondary sex characteristics associated with masculinity. (80)

Adrenal glands. Endocrine glands located at the upper end of the kidneys; consist of inner adrenal medulla, which secretes the hormones *adrenaline* and *noradrenaline* during strong emotion, and outer adrenal cortex, which secretes the *adrenal androgens* and

other hormones that influence maturation. (63)

Adrenaline. Hormone secreted by the adrenal medulla in strong emotion; causes a number of bodily changes, including an increase in blood sugar, a rise in blood pressure, and a more rapid pulse rate. (64; 423)

Affective reaction. Psychosis characterized by extreme fluctuations of mood. (486)

Afferent neuron. Neuron which carries messages toward the central nervous system from a receptor cell; also known as a *sensory neuron*. (44)

Afterdischarge. Process whereby, because of self-exciting circuits and impulses traveling through long-circuit chains, a single stimulus can cause a motoneuron to discharge for several seconds or minutes. (51)

Afterimage. See *Negative afterensation* and *Positive afterensation*.

Aggression. A response that delivers hurtful stimuli to another object or person. (404)

Aggressive reaction. A response to frustration in which the source of frustration or some substitute is attacked. (464)

Agnosia. A disorder of perception in which sensations are felt but cannot be organized into normal perceptions. (60)

Alarm reaction. See *General-adaptation-syndrome*. (440)

All-or-none principle. Principle that if a nerve fiber responds at all, it responds with full strength. (47)

Alpha rhythm. The electrical rhythm typical of the brain during normal wakefulness. (242)

Ambivalence. Experiencing both positive and negative feelings toward the same person or object. (512)

Amnesia. Loss of memory, especially of past personal experiences. (481)

Amplitude. Height of light waves, determining brightness; intensity of sound waves, determining volume. (270; 277)

Ampullae. Swellings at the base of the semicircular canals; contain hair cells which are the chief receptors for accelerating or decelerating motion. (287)

Amygdala. Area in the rhinencephalon whose destruction causes excessive sexual behavior and a cessation of rage and savageness. (434)

Anal period. In psychoanalytic theory, stage of development during which bowel control is achieved and the focus of pleasure is the eliminative processes. (120)

Anal personality. Personality characterized by miserliness and obsessive orderliness, traits which, according to psychoanalytic theory, are related to unsatisfied cravings during the period of preoccupation with elimination. (121)

Analysis of covariance. A complex procedure involving a blend of analysis of variance and correlation; used to achieve statistical control. (640)

- Analysis of variance.** Technique for determining the statistical significance of differences among the dependent variable means of different experimental groups. (635)
- Analytical psychology.** The personality theory of Jung, which emphasizes the purposive aspect of personality and regards the integration of the conscious and unconscious parts of the personality into a unified self as the individual's highest goal. (123)
- Anatomical method.** Method of studying brain functions by tracing nerve pathways in nonliving tissue under a microscope. (53)
- Androgen.** Male hormone which regulates sexual development; some androgens are produced by the testes and others by the adrenal cortex. (80; 81; 389)
- Anomie.** Loss of the sense of personal identity. (503)
- Anoxia.** Lack of sufficient oxygen. (386)
- Anxiety.** Generalized feelings of apprehension; a symptom of many neuroses and psychoses. (476)
- Aphasia.** Impairment of ability to use or understand language, even though hearing and speech mechanisms are unimpaired. (60)
- Applied science.** Study which seeks and uses scientific knowledge for some practical purpose. (18)
- Approach-approach conflict.** Form of conflict frustration in which the individual must choose between two desirable but mutually exclusive goals. (462)
- Approach-avoidance conflict.** Form of conflict frustration in which the individual is at the same time attracted and repelled by the same goal. (462)
- Apraxia.** Inability to perform common manipulations of objects in the absence of true paralysis. (60)
- Aptitude tests.** Instruments designed to measure capacity to learn or perform certain tasks. (153)
- Arousal.** General energizing component of motivation; involves organs controlled by both central and autonomic nervous system. (376)
- Ascending reticular system.** System of ascending nerve fibers over which impulses go to the cortex from the subcortical areas. (345) See also *Reticular formation*.
- Assimilation effect.** Tendency to misperceive a trusted speaker's stand as being closer to the subject's own stand on an issue than it really is. (603)
- Association areas.** Areas of the cerebral cortex which serve to correlate and integrate the functions of the sensory and motor areas. (59)
- Associationistic theories of learning.** Theories which regard learning as a process of forming associative bonds or connections. (217)
- Asthenic reaction.** Neurotic reaction in which the individual feels tired all the time and suffers from mild physical symptoms in the absence of known organic pathology. Formerly called *neurasthenia*. (484)
- Astigmatism.** Visual defect caused by unequal curvature of the cornea and/or lens, producing unfocused, fuzzy vision in one dimension. (769)
- Atmospheric perspective.** Difference in clarity between near and far objects; an aid in depth perception. (316)
- Attention.** The process of psychological selectivity by which we select, from a vast number of potential stimuli, only those which are related to present interests and needs. (295)
- Attitude.** A relatively stable, learned, emotionalized predisposition to respond in some consistent way toward an object, person, or situation. (198)
- Auditory area.** Cortical area in the wall of the fissure of Sylvius on each temporal lobe, to which fibers from both ears are connected. (281)
- Auditory nerve.** Nerve which transmits impulses from the Organ of Corti to the brain. (280)
- Autistic thinking.** Thinking as an end in itself and not a means to an end; determined primarily by the individual's needs or desires, as in daydreaming. (335)
- Autokinetic movement.** The apparent movement of a small stationary point of light in a dark room. (312)
- Autonomic nervous system.** That part of the nervous system which regulates bodily activities not subject to voluntary control, including the visceral changes that occur during emotion; composed of the sympathetic and parasympathetic divisions. (43; 428)
- Avoidance conditioning.** Instrumental aversive conditioning in which the organism can prevent an unpleasant stimulus by making an appropriate response in time. (189)
- Avoidance-avoidance conflict.** Form of conflict frustration in which the individual cannot avoid one alternative without encountering the other. (462)
- Axon.** Long fiber leading from the cell body of the neuron, terminating in end brushes. (46)
- Basilar membrane.** Membrane in the cochlea on which is located the Organ of Corti; varies in width and responds selectively to impulses of lower frequency as it becomes wider. (280)
- Behavior.** Isolated reactions and organized, goal-directed patterns of reaction which can be observed objectively and internal processes such as thinking and emotional reactions, which can only be observed introspectively or inferred from external behavior. (8)
- Behavior therapy.** See *Action therapies*.
- Behavioral science.** A coordinated discipline in which psychologists, sociologists, and anthropologists work together on the problem of developing valid generalizations about human behavior. (9)
- Behaviorists.** School of psychologists who restricted their study to man's overt behavior, believed to be determined by stimulus-response connections. (7)
- Behavior sampling.** Technique for measuring personality traits; the examiner observes the subject's behavior in a specified situation, without the subject's knowledge. (150)
- Between variance.** The variability between samples; an estimate of the population variance based upon the variation due to the independent variable as well as that due to random effects. (638; 639)
- Bilateral symmetry.** Condition in which the two halves of an object or organism are essentially alike. (186)
- Biographical method.** Technique by which the psychologist seeks to understand behavior by analyzing the records of men's lives. (25)
- Biological drives.** Innate drives resulting from basic tissue needs. (378)
- Bipolar cells.** First neurons in the visual pathway; conduct messages from the rods and cones to ganglion cells. (266)
- Bit.** Unit of information; amount of information which,

- when put into a system, reduces the number of alternatives by half. (370)
- Blind spot.** Region of the retina where nerve fibers leave the eye; no rods or cones are found here. (260)
- Blur point.** Distance from eyes at which print becomes blurred, as it is moved closer to the eyes. (269)
- Brain potentials.** Brain waves; minute oscillations of electrical potential given off by the cerebral cortex; measured by the electroencephalograph. (339; 431)
- Brain stem.** Term used to designate all the structures that lie between the cerebrum and the spinal cord. (56)
- Brainstorming.** A technique for stimulating creativity in group or individual problem solving, consisting of a "green light" stage in which solutions are suggested and a "red light" stage in which they are evaluated. (368)
- Brainwashing.** Intensive form of propaganda, often conducted under emotional stress but typically without corporal punishment. (612)
- Brightness.** Quality of color determined by the amplitude (height) of the light wave, greater amplitude causing a brighter (lighter) color. (270)
- Broca's area.** Area in frontal lobe of cerebral hemisphere above the fissure of Sylvius; important for speech. (59)
- Catatonia.** Schizophrenic reaction characterized by motionless, unresponsive stupor. (488)
- Catharsis.** The discharging of emotional tension by "talking out" or otherwise expressing troubled emotions; important in most psychotherapy. (508)
- Cell body.** Thickened portion of cell, containing nucleus. (45)
- Centiles.** Points which divide a distribution of measurements into 100 equal parts; sometimes called percentiles. (143; 623)
- Central nervous system.** The brain and spinal cord. (43)
- Central value.** A statistic which represents the average or typical value of a series of measurements; common central value measures are the *mean*, the *median*, and the *mode*. (139; 618)
- Centralist theories.** Cognitive learning theories, which emphasize the importance of organizing processes as central to learning. (217)
- Centrifugal impulses.** "Wrong-way" impulses which go from the cerebral cortex down to the relay stations of the sensory pathways and in some cases out to the sense organs; serve to block certain stimuli so that others can be attended to. (296)
- Centripetal impulses.** Systems of impulses which go from the sense organs toward the brain centers; "right-way" impulses. (296)
- Cerebellum.** The part of the brain that controls the coordination of movements necessary for balance in sitting, walking, and manipulation. (43)
- Cerebral cortex.** A thin, grayish rind of tissue covering the cerebrum; active in conscious experience and higher mental processes. (55)
- Cerebral dominance.** Control of a function of both sides of the body by one side of the cerebrum. (62)
- Cerebrum.** The main part of man's brain, divided into right and left hemispheres; also known as the new brain. (54)
- Chemical methods.** Methods of studying brain function by applying chemicals to selected brain areas. (54)
- Chemical senses.** The senses of smell and taste. (289)
- Chemotherapy.** Use of drugs in therapy. (530)
- Choroid coat.** Middle layer of coating of the eye. (259)
- Chromatin body.** Microscopic structure found in cells of female organisms, which takes a deep stain while male cells will not. (77)
- Chromosomes.** Small bodies, found in pairs, which contain the genes responsible for hereditary traits; half an individual's chromosomes (23) come from the mother, half (23) from the father, making a total of 46 in normal human cells. (74)
- Claivoyance.** Form of extrasensory perception in which the subject supposedly becomes aware of an external object without the use of his sense organs. (332)
- Classical conditioning.** See *Conditioning*. (181)
- Client-centered therapy.** A nondirective technique of psychotherapy based on the theory that many individuals can work through their own problems by "talking them out" in a permissive and supportive atmosphere. (508)
- Clinical method.** A method of studying human behavior in which the life history of the individual is reconstructed on the basis of all available information, usually in an effort to discover the cause of some maladjustment. (25)
- Clinical psychologist.** Nonmedical psychologist who practices psychotherapy. (11; 507)
- Closure.** Perceptual process by which we "close" gaps in a figure so that we see it as a whole figure. (304)
- Cochlear canals.** Canals of the inner ear, containing fluid which is set in motion by vibrations of the oval window and which in turn stimulates the basilar membrane. (280)
- Cognitive dissonance theory.** Principle that dissonant (unbalanced or incongruous) cognitions tend to become more congruous, better balanced. (360)
- Cognitive learning theories.** Learning theories which regard learning as a process of making new differentiations and discriminations or reorganizing material into new patterns. (217)
- Collaterals.** Branches of neurons. (46)
- Collective unconscious.** In Jungian theory, racial unconscious or storehouse of racial memories with which every person is thought to be endowed. (124)
- Color blindness.** Visual defect in which the individual cannot distinguish hues which appear different to people with normal color vision; may be total, caused by absence of cones, or *dichromatic*. (275)
- Color solid.** Double cone which classifies colors three-dimensionally, with points along the vertical axis representing degrees of brightness, points along any radius representing degrees of saturation, and points around the circumference representing the different hues. (271; Color Plate I)
- Color wheel.** Cross section of the color solid; shows the relationships between hues. (271; Color Plate I)
- Commissures.** Connecting fibers between the two hemispheres of the brain. (61)
- Compensation.** Attempt to disguise the presence of a

- weak or undesirable trait by emphasizing a desirable one. (473) See also *Overcompensation*.
- Complementary colors.** Two colors located opposite each other on the color wheel; complementary colors combine to give gray. (272)
- Complementary tastes.** Tastes which tend to neutralize each other if mixed. (290)
- Compromise reaction.** A response to frustration in which the individual partially gives in to the frustrating obstacle but without entirely relinquishing his original goal. (472)
- Compulsion.** Bizarre action which the individual himself does not understand but nevertheless feels impelled to perform; usually symbolic in nature. (480)
- Concept.** Abstract idea derived from the grouping of objects in terms of some common property. (345)
- Conditioned inhibition.** Process by which the organism becomes conditioned not to respond; occurs when a conditioned stimulus and a neutral stimulus are presented together and not followed by reinforcement. The neutral stimulus becomes the suppressor. This is not the same as simple extinction because the CS alone still elicits the CR. (185)
- Conditioned response (CR).** A learned response to a stimulus not originally capable of arousing the response. (182)
- Conditioned stimulus (CS).** A previously neutral stimulus which has become capable of evoking a particular (conditioned) response. (182)
- Conditioning.** A basic form of learning in which conditioned responses are established. In classical conditioning, a response comes to be evoked by a previously neutral stimulus when this stimulus is paired for a number of trials with the (unconditioned) stimulus which normally elicits the response. In *instrumental* conditioning, no eliciting stimuli are presented; the subject is placed in a situation where he learns to make an instrumental response leading to reward or, in *aversive* conditioning, one which terminates or prevents an unpleasant stimulus. (181-182; 186-188)
- Cones.** Retinal receptor cells sensitive to both hue and brightness and responsible for color vision. (260)
- Confidence interval.** An interval of measurements with a known probability of containing a parameter. (634)
- Conjugate movements.** Simultaneous movements of the eyeballs in changing the fixation from one equidistant point to another; comprise jump and pursuit movements. (262)
- Connectors.** Biological structures which connect receptors with organs of response; used primarily with reference to the nervous system, but also including the bloodstream and certain chemical substances. (41)
- Consummatory response.** Action which represents the completion of goal-seeking activity. (375)
- Contiguity theory.** Learning theory which emphasizes the role of temporal contiguity of stimulus and response, holding that learning occurs regardless of whether reinforcement is given, so long as the conditioned stimulus and the response occur together; espoused by Guthrie and Watson. (216)
- Continuous reinforcement.** Reinforcement given regularly after each conditioning trial. (183)
- Contrast effect.** In persuasive communication, tendency to displace a speaker's message away from the subject's own stand on an issue; occurs when the speaker arouses negative feeling in the subject. (603) In taste, tendency of relatively sour things to taste more sour if sweet things are tasted first. (290) See also *Simultaneous brightness contrast* and *Simultaneous hue contrast*.
- Control group.** Group of subjects for which the experimenter holds the independent variable under control either by keeping it constant or by removing it from the situation entirely. (27)
- Convergence.** In the nervous system, distributing process whereby impulses from many neurons or receptor cells reach the same neuron or effector; makes it possible for the same muscle fiber to take part in many different reflexes. (49; 266) In vision, process by which the eyes turn toward each other when focusing upon objects closer than about twenty feet so that both eyes fixate the same point in space; a cue in depth perception. (262; 315)
- Conversion reaction.** Neurotic reaction to stress in which psychological distress is converted into bodily symptoms; formerly called *hysteria*. (483)
- Cornea.** Transparent portion of the protective coating of the eye, in front of the lens. (260)
- Corpus callosum.** Massive bundle of fibers connecting the two hemispheres of the brain. (61)
- Correlation.** The degree to which two attributes are related. (143; 624)
- Correlation coefficient.** A statistic which summarizes the relationship of two sets of measurements taken on the same sample. (143; 624)
- Corticotropin.** A pituitary hormone which interacts with the secretions of the adrenal cortex—an important factor in rheumatoid arthritis and other disorders; also called *ACTH*. (64)
- Covert trial and error.** Trial and error in which alternatives are eliminated by thought instead of action. (353)
- Cretinism.** Retarded development of the skeletal and nervous systems caused by thyroid deficiency during infancy or early childhood; often accompanied by low intelligence. (80)
- Criterion.** A standard of judging; a rule or test by which anything is judged. (204; 632)
- Critical ratio.** A ratio whose numerator is the difference between an obtained statistic and the parameter expected under the null hypothesis, and whose denominator is the standard error of the statistic if the null hypothesis is assumed; used to test statistical significance. (632)
- Critical region.** That part of a sampling distribution into which a statistic must fall if the null hypothesis is to be rejected at a given level of statistical significance. (633)
- Cross-sectional approach.** Method of studying the effects of age on various traits by grouping a large number of subjects according to their ages and using one set of tests for all. (105)
- Cue function.** Indication of the direction of appropriate activity. (377)
- Curve of decreasing returns.** Graphic representation of a learning situation in which the greatest improvement

- in performance occurs during the early trials; the most commonly obtained learning curve. (207)
- Curve of equal returns.** Graphic representation of a learning situation in which early trials yield the same amount of improvement as later trials; essentially a straight line. (206)
- Curve of increasing returns.** Graphic representation of a learning situation in which improvement is greater in later trials than in early trials. (206)
- Cutaneous senses.** Senses of pressure, pain, warmth, and cold, located primarily in the skin. (283)
- Cybernetics.** Science of control and communication in the organism and machine. (341)
- Cyclofusal movement.** Independent rotation of each eye about its axis so that light from an object strikes corresponding points on the two retinas. (262)
- Dark adaptation.** Process by which the eyes become more sensitive so that they can see under low illumination; usually requires about half an hour of darkness. (260)
- Davis-Eells Games.** An intelligence test designed in such a way, it was hoped, as to be culture fair, with problems whose content is not limited to the experience of any socioeconomic level. Such tests are low in reliability and validity. (168)
- Daybook method.** A form of the life-history method of obtaining data, usually employed in observing children; the individual's development is carefully observed and recorded day by day. (24)
- Decibel.** Unit of measurement of the intensity of sound. (279)
- Defense mechanisms.** Complex and varied behavioral devices which individuals employ usually unconsciously, in handling frustrations. (462)
- Degrees of freedom (df).** Number of independent observations upon which an estimate of a parameter is based. (628)
- Delayed reaction.** Introduction of a brief waiting interval after a stimulus before a previously learned response can be made; a measure of ability to carry images or symbols in the memory. (337)
- Delirium tremens.** Organic psychosis with visual hallucinations, resulting from severe alcoholism. (488)
- Delusion.** A strong belief opposed to reality and maintained in spite of logical persuasion and evidence to the contrary; symptom of psychosis. Three main types: *delusion of grandeur* (belief that one is an exalted personage), *delusion of persecution* (belief that one is being plotted against), and *delusion of reference* (belief that chance happenings and conversations concern oneself). (486)
- Dendrites.** Highly branched, usually quite short fibers at the receiving end of the neuron. (46)
- Dependency.** A class of responses capable of eliciting positive attending and ministering responses from others; may be task-oriented or person-oriented. (407)
- Dependent variable.** In an experiment, the factor which the hypothesis predicts will change with changes in the independent variable. (27)
- Depressive reaction.** Neurotic reaction in which the individual reacts to a frustrating situation or a loss with greater sadness and for a longer time than the normal person would. (484)
- Descriptive statistic.** A number which stands for a series of measurements collected on a group. (618)
- Dichromat.** Person who has normal vision for only two primary colors, usually yellow and blue. (276)
- Difference limen.** Smallest detectable difference in stimulus intensity. See also *Weber's law*. (257)
- Dimension.** A characteristic which can be measured and expressed in numerical terms. (17)
- Diplopia.** Double vision; may be caused by hereditary weakness of eye muscles or by disease, poison, or (temporarily) alcohol. (269)
- Directive counseling.** Least complicated type of psychotherapy, in which the therapist supplies reassurance, suggestions, or direct solutions. (508)
- Discrimination learning.** Learning in which the task is to distinguish between two or more stimuli or between stimulus and no stimulus. (191)
- Disinhibition.** Temporary reappearance of a conditioned response which has been extinguished, in response to an extraneous stimulus different from the conditioned stimulus; inhibition of an inhibition. (185)
- Displaced aggression.** Transfer of hostility from the object or person actually causing frustration to some other object or person or to the self. (464)
- Dissoctative reactions.** Neurotic reactions to extreme stress in which entire episodes of life are repressed from consciousness, as in amnesia, fugue, and multiple personality. (480)
- Distributed practice.** Use of spaced learning periods. (231)
- Divergence.** Distributing process in the nervous system whereby impulses from a single neuron or receptor cell reach many neurons or muscles. (50; 266)
- Dizygotic.** Developed from two separate but simultaneously fertilized eggs, or zygotes; refers to fraternal twins. (77)
- DNA.** Deoxyribonucleic acid; principal component of the genes. (74)
- Dominant gene.** Gene of an opposing pair which takes effect to produce a hereditary trait. (76)
- Double alternation test.** Test of ability to learn a sequence, as: left, left, right, right, left, left, right, right; used as a measure of thinking ability. (338)
- Double approach-avoidance conflict.** Form of conflict frustration in which both alternatives have attractive and undesirable features. (462)
- Double-blind technique.** Method of studying the effectiveness of drugs or other treatments in which neither the subjects nor the individuals evaluating the results know which ones received which treatment. (531)
- Drive.** Complex of internal conditions directing the organism toward a specific goal; a motive. (375)
- Dwarfism.** Underdevelopment of the bones caused by a deficiency of the pituitary growth hormone early in life. (79)
- Dyad.** Two-person team. (553)
- Eardrum.** Thin membrane which separates the external ear from the middle ear; made to vibrate by the pressure impulses of sound waves. (280)
- EEG.** See *Electroencephalogram*. (242)

- Effectors.** The organs (muscles or glands) which perform the actual response functions. (44)
- Efferent neuron.** Neuron which carries messages from the central nervous system to an organ of response; also known as motoneuron. (44)
- Ego.** In psychoanalytic theory, the rational aspect of the personality; regulates the impulses of the id in order to meet the demands of reality and maintain social approval and self-esteem. More generally, the individual's concept of self. (120)
- Ego-involvement.** Perception of a situation in terms of its potential effect on one's self concept. (462)
- Eidetic imagery.** Mental imagery, usually visual, which is almost like actual perception in its clarity and accuracy; rare but most often found in children. (342)
- Effect, law of.** Theory holding that satisfying events strengthen S-R connections and annoying events weaken them; proposed by Thorndike. (216)
- Electroconvulsive shock.** Form of therapy for mental illness; electric current passed through the brain produces instant unconsciousness and convulsions. (528)
- Electroencephalogram (EEG).** Recording of the minute electrical oscillations of the cerebral cortex known as brain potentials or brain waves. (242)
- Elicited behavior.** In conditioning, a response already in the organism's repertoire which is initiated by some recognizable physical stimulus. (186)
- Embryo.** The organism between conception and birth or hatching. In humans, the organism from the second to the eighth week after conception. (84)
- Emergency reaction.** The alarm reaction stage of the general-adaptation-syndrome. (440)
- Emitted behavior.** Behavior which appears without the use of an external stimulus to initiate it; basis of instrumental conditioning. (186)
- Emotion.** Complex state of feeling involving conscious experience, internal and overt physical responses, and power to motivate the organism to action. (415)
- Empathy.** Ability to understand and to some extent share another person's feelings. (417)
- Encephalization.** Increasing concentration of neural components in the head region, eventually constituting a brain, in ascending forms on the evolutionary scale. (43)
- End brushes.** Tiny fibers at end of an axon. (45)
- End plates.** Structures at the end of the axons of motoneurons, corresponding to end brushes. (46)
- Endocrine glands.** Ductless glands; secrete their substances (hormones) directly into the blood stream. (62; 79)
- Energetics.** Variability in the intensity of responding; one of the two basic but interacting characteristics of human and animal behavior. (375) See also *Plasticity*.
- Energizer.** Drug which stimulates the patient, making him feel more energetic. (532)
- Engram.** Memory trace; formed and temporarily stored during learning but must be stored through a process of consolidation or it is rapidly lost. (202)
- Environment.** The totality of conditions within and surrounding the organism that serve to stimulate behavior or act to bring about change of behavior. (69)
- Epidemiology.** Study of the incidence, distribution, and control of physical or mental disease. (503)
- Escape conditioning.** Instrumental aversive conditioning in which the organism can stop an unpleasant stimulus by making the appropriate response. (188)
- Estrogens.** Female hormones produced by the ovaries; promote growth in the reproductive organs and other body parts important to child-bearing and motherhood. (81; 390)
- Estrus.** Period when a female lower mammal is highly receptive or even aggressive in sexual behavior, a signal that she is in readiness for pregnancy; popularly called heat. (390)
- Eustachian tube.** Tube leading from the middle ear to the throat; provides for the maintenance of equal air pressure on both sides of the eardrum. (280)
- Evoked potentials.** Electrical responses made by the brain to specific sensory stimuli. (339)
- Excitatory postsynaptic potential (EPSP).** Potential change which occurs in a neuron when a nerve impulse is approaching it from a synaptic knob; not subject to all-or-none law: when it builds to certain size, an impulse is set up in the neuron. (48)
- Existentialism.** Philosophy which emphasizes the importance of existence as primary, with man himself responsible for the kind of person he shall be; a personality theory which emphasizes a sort of self-actualization, although not generally optimistic. (127)
- Experimental control.** In the experimental method, holding constant all variables other than the independent variable which might affect the outcome. (27)
- Experimental extinction.** Gradual disappearance of a conditioned response when the conditioned stimulus is repeated without being reinforced. (183)
- Experimental group.** Group of subjects for whom the experimenter alters the independent variable whose influence he wishes to study. Cf. *Control group*. (27)
- Experimental method.** The most highly formalized scientific method, in which hypotheses are tested under precisely specified conditions. (26)
- Extinction.** See *Experimental extinction*.
- Extirpation method.** Method of studying brain function in animals by systematically destroying part of the brain and observing behavioral changes. (53)
- Extrasensory perception (ESP).** Becoming aware of objects or ideas without use of the sense organs; comprises the phenomena of mental telepathy, clairvoyance, and incorporeal personal agency; not definitely established as a reality. (332)
- Extraversion.** Orientation toward the external world of things and people; the extravert tends to enjoy social contacts. (124)
- F distribution.** The sampling distribution expected from a large number of F ratios. (640)
- F ratio.** The ratio of the between sample variance to the within sample variance. (639)
- Factor analysis.** The statistical technique of identifying and measuring the relative importance of the underlying variables, or factors, which contribute to a complex ability, trait, or form of behavior. (146)
- Factorial design.** Experimental design in which the independent variables are studied in all possible combinations. (641)
- Fantasy.** Withdrawal reaction in which the individual

- escapes from frustration through daydreaming. (468)
- Feeble-mindedness. See *Mental retardation*. (159)
- Feedback. Error-correcting information returned to the control center of a servomechanism or to the nervous system and brain of a living organism, enabling it to offset deviations in its course toward a goal. (341)
- Fetus. The unborn human organism from the eighth week after conception until birth. (84)
- Field-study method. Research technique in which the investigator observes the subjects under their usual environmental conditions without attempting to control the conditions and often without the subjects' knowledge that they are being observed. (24)
- Field theory. The systematization of psychology by analogy with fields of force in physics, maintaining that all experience has field properties which make the total experience (or total field) greater than the sum of its parts. (125)
- Fissure of Rolando. Deep, nearly vertical furrow or groove on the side of each cerebral hemisphere, separating the frontal and parietal lobes; also known as the central sulcus. (54)
- Fissure of Sylvius. Deep horizontal groove on the lateral surface of each cerebral hemisphere, separating the temporal from the frontal and parietal lobes; also called the lateral fissure. (54)
- Fixed interval schedule. Schedule by which reinforcement is given regularly at the end of a certain period of time, such as every two minutes. (189)
- Fixed ratio schedule. Schedule by which reinforcement is given regularly after a certain number of correct responses. (189)
- Forced-choice method. Method of reducing faking on self-inventories and rating devices in which the rater must choose from alternatives of equal desirability. (150)
- Form board. A board with recesses into which the subject must fit blocks of the proper size and shape as quickly as he can; used as a performance test to measure intelligence. (155)
- Fovea. Area in center of retina with greatest density of cones and complete absence of rods; area of clearest daytime vision. (260)
- Fraternal twins. Twins which, unlike identical twins, develop from two separate fertilized eggs and do not resemble each other any more closely than other brothers and sisters. Also called *dizygotic twins*. (77)
- Free association. Principal procedure used in psychoanalysis to probe the unconscious; patient lets his mind wander freely, giving a running account of every thought and feeling. (510)
- "Free-floating" anger. Chronic reaction pattern in which hostility becomes generalized so that even neutral situations are met with hostility. (464)
- "Free-floating" anxiety. Chronic reaction pattern in which anxiety becomes generalized and patient feels a sense of impending doom for no specific reason; may become fixed on specific objects in the form of phobias. (476)
- Frequency distribution. A distribution showing the number of times each measurement value occurs in a sample. (629)
- Frequency theory. See *Telephone theory*.
- Frontal lobe. Portion of each half of the cerebrum located in front of the fissure of Rolando and above the fissure of Sylvius. (55)
- Frustration. Denial or thwarting of motives by obstacles which lie between organism and goal; may be environmental, personal, or the result of conflict. (461)
- Fugue. Loss of memory accompanied by actual physical flight. (481)
- Functional explanation. Explanation of an event in terms of its use or purpose. (113)
- Functional fixedness. Inability to see a new use for a familiar tool. (362)
- Functional psychosis. Severe mental disorder precipitated primarily by psychological stress. (490)
- Functionalists. School of psychologists who define mental phenomena in terms of their function or activity in adjusting to the environment. (7)
- Funneling. Process by which, through a ring of inhibition around a core of excited fibers, auditory sensations are sharpened; fibers on the periphery contribute to the intensity of the sensation but do not change the frequency, which is that of the tone conducted by the central fibers. (280)
- Galvanic skin response (GSR). Increase in voltage and/or change in electrical resistance of the skin during emotion as a result of action of the autonomic nervous system on the sweat glands. Also called *psychogalvanic response*. (424)
- Gamete. Male or female germ cell; contains only half the number of chromosomes found in the other cells of the body. (74)
- Ganglion (pl. ganglia). A collection of nerve cells and synapses located outside the central nervous system. (42; 266)
- Gating. Process of inhibiting certain stimuli and "opening the gate" so that one at a time can pass through, making attention possible; performed by the "wrong-way" or centrifugal nerve fibers. (297)
- General-adaptation-syndrome. The body's reaction under continued stress, consisting of the *alarm reaction*, during which the body makes a number of complicated physiological changes in response to a stressor; the stage of resistance, during which the organism, with the aid of increased secretions of the adrenal glands, is able to withstand the stressor for a time without showing symptoms; and the *stage of exhaustion*, in which the organism can no longer resist the stressor and may die if stress does not cease. (440)
- Genes. Ultramicroscopic areas within the chromosomes; the real bearers of heredity. (74)
- Genetic explanation. Explanation of an event in terms of a description of the sequence of major events leading up to it. (113)
- Germ cells. Reproductive cells (male sperm and female ovum) which unite to produce a new individual. (74)
- Germinal period. First two weeks of prenatal development, during which the zygote develops by division into a hollow sphere of cells. (84)
- Gestalt psychology. A school of psychology which teaches that psychology should study the whole pattern of behavior instead of analyzing it into elements, since

- the whole is more than the sum of its parts. (7)
- Giantism.** Overgrowth of the skeletal structure caused by oversecretion of the pituitary growth hormone early in life. (79)
- Goal.** Some substance, object, or environmental condition capable of reducing or temporarily eliminating the complex of internal conditions which initiated action on the part of an organism. Also called reward, incentive, or reinforcement. (375)
- Gonads.** The sex glands (testes in the male and ovaries in the female); produce gametes and also secrete hormones which influence bodily development and behavior. (64)
- Group therapy.** Form of psychotherapy in which a group of persons discuss their problems under the guidance of a therapist; usually nondirective. (519)
- Guidance center.** Clinic or agency where individuals may be helped with problems of adjustment. (505)
- Gustatory area.** Area of the brain responsible for taste sensations is not yet located in man; may be in the somesthetic area near the centers controlling the tongue. (292)
- Habit strength.** In Hull's theory of learning, a learned connection between stimulus and response (an intervening variable), represented by the symbol *H_r*. (215)
- Hallucination.** Sensory impression of external objects in the absence of any appropriate stimulus in the environment. (487)
- Halo effect.** Tendency, when interviewing or rating an individual on a particular trait, to be influenced by one's opinion of some other trait or by the individual's personality as a whole. (128)
- Harmonics.** See Overtones.
- Hemianopia.** General term for blindness on one half of the field of vision of one or both eyes. (265)
- Heredity.** The totality of biologically transmitted factors that influence the structure of the body and thus limit behavior. (69)
- Heterozygous.** Possessing two unlike genes for a particular trait. (76)
- Higher-order conditioning.** Process by which, once a conditioned response has been established, the conditioned stimulus may in turn function as an unconditioned stimulus in setting up a conditioned response to a third stimulus. (184)
- Hippocampus.** A subcortical structure of the brain which is crucial for recent memory. (201)
- Holistic theories.** Cognitive learning theories, so-called because of their emphasis on the importance of the whole in shaping the parts. (217)
- Homeostasis.** The complex process of maintaining stability in the internal and external environment so that the body's chemical balance can be maintained and personality needs can be satisfied; homeostasis on the physiological level is largely automatic. (62; 393)
- Homozygous.** Possessing two identical genes for a particular trait. (76)
- Homotic traits.** Direct motivational aspects of the person, which depend upon both tissue needs and the kinds of experience the individual has had. (146)
- Hormones.** Secretions of the endocrine (ductless) glands. (62; 79)
- Hue.** Quality of color sensation determined by the wave length of the light waves. (270)
- Human engineering.** Planning of work space and equipment in accordance with the sensory capacities, strength, and body dimensions of the worker, so as to bring about maximum efficiency while maintaining maximum safety and comfort of the operator; also called *engineering psychology*. (14)
- Hyperalgesia.** Exceptional sensitivity to pain. (285)
- Hyperopia.** Far-sightedness, caused by the lens being unable to bulge out enough for close vision; image comes into focus behind the retina. (269)
- Hypnosis.** Artificially induced state of extreme suggestibility; used in psychotherapy primarily as an aid in uncovering repressed or forgotten experiences. (521)
- Hypnotic regression.** Process by which a subject vividly relives, under hypnosis, early experiences which he has forgotten or repressed. (522)
- Hypnotic suggestion.** Process of inducing acts, thoughts, or feelings in the subject while hypnotized. See also *Posthypnotic suggestion*. (521)
- Hypochondria.** Neurotic preoccupation with the body's activities and the state of one's health. (484)
- Hypothalamus.** Key subcortical structure at base of brain; important in temperature regulation, emotion, motivation, and other activities; controls endocrine system. (56; 63)
- Hypothesis.** Statement or proposition, often based on the results of previous observations, which is tested in an experiment; it may be denied or supported by the results but never conclusively proved. (27)
- Hysteria.** See *Conversion reaction*.
- Id.** In psychoanalytic theory, the primitive part of the unconscious, composed of instinctive organic cravings and characterized by unrestrained pleasure-seeking impulses. (120)
- Identical twins.** Twins which develop from a single fertilized egg; also called *monozygotic twins*. (77)
- Identification with the aggressor.** Defense mechanism by which the frustrated individual incorporates into his own personality structure the qualities of those who threaten him. (474-475)
- Idiographic.** Approach to personality study in which the unique aspects of an individual's personality are of chief importance. (113)
- Idiot.** Former classification of individual with IQ of 25 or less. (159) See *Mental retardation*.
- Imbecile.** Former classification of individual with IQ of 25 to 50. (159) See *Mental retardation*.
- Implicit speech.** Tiny muscular contractions, in the speech mechanism and elsewhere, which occur during thought. (340)
- Implosive therapy.** Form of action therapy developed by Stampf; extinction occurs as frightening stimuli are imagined; called *implosive* because the frightening stimuli produce an inner explosion—an *implosion*—of panic. (514)
- Imprinting.** A form of learning which occurs very early in life and determines the form which behavior will take, as in the case of ducklings which follow the first

- moving object they see and remain closely attached to it. (192)
- Incidental learning.** Ability to notice and remember things which are not immediately relevant to the task at hand; also called *latent learning*. (222)
- Inclusiveness.** Factor by which we use up all the elements in perceiving a pattern. (304)
- Incus.** The second of three hinged bones in the ear which together transmit vibrations from the eardrum to the oval window; also called the *anvil*. (280)
- Independent variable.** Factor whose effects are being examined in an experiment; it is changed in some systematic and predetermined manner while the other variables are held constant. (27)
- Individuation.** Pattern of development from general to specific; characteristic of the maturation process. (82)
- Inferiority complex.** Deep-rooted but concealed feelings of inferiority which, according to Adlerian theory, often lead to a lust for domination over others as a means of compensation. (124)
- Information.** In information theory, a reduction in uncertainty. (369)
- Information theory.** The study of communication systems and the principles that make for understanding, control, and predictability in communication. (369)
- Inhibition.** Suppression or restraint of behavior; term has many specific meanings. (40)
- Inhibitory postsynaptic potential (IPSP).** Potential change occurring in a neuron which suppresses the development of a nerve impulse. (48)
- Innervation.** The excitation of a muscle or gland by a nerve. (49)
- Input.** In cybernetics, the stimuli which initiate the activity of a machine or an organism. (341)
- Insanity.** A legal concept applied to any mental condition which renders the individual incapable of intent and thus legally irresponsible for his actions. (485)
- Insight.** In Gestalt theory, the apparently sudden appearance of the solution to a problem. In psychotherapy, the understanding of one's own behavior, motives, feelings, and attitudes. Awareness of key relationships, not always sudden. (353)
- Insight therapies.** Forms of psychotherapy which seek to enable the patient to find his underlying conflict or problem and gain insight into it. (513)
- Instinct.** Behavior pattern whose underlying biological pattern is produced by maturation rather than learning and which appears fullblown upon the first occasion that an adequate stimulus is presented, without the organism's having previous opportunity to learn; common in lower animals but very rare in man. (71)
- Instrumental conditioning.** See *Conditioning*.
- Insulin.** Hormone secreted by the pancreas which helps the body to metabolize sugar and keep the blood sugar level steady. (62)
- Insulin shock.** Treatment of mental disturbance by administration of insulin to produce a period of coma followed by a lucid period which can be used for psychotherapy; seldom used today. (528)
- Integrated therapy.** Psychotherapy based on an eclectic approach, stressing no particular theory or procedure but using whatever methods of therapy seem appropriate to the individual case. (535)
- Integrity therapy.** A form of psychotherapy developed by Mowrer; regards neuroses as forms of moral failure and advocates taking the consequences of one's actions and being more faithful to moral values. (515)
- Intellectualization.** A defensive compromise reaction in which the individual attempts to divest his problems of painful feelings by pushing them into the realm of the intellect through rationalization, isolation, or undoing. (473)
- Intelligence.** Complex mental ability; includes such primary abilities as verbal comprehension, space visualization, reasoning ability, numerical ability, and others; operationally defined, intelligence is what intelligence tests measure. (161)
- Intelligence quotient (IQ).** Measure of intelligence obtained by dividing the individual's mental age (MA), as determined by his performance on standardized test items, by his chronological age (CA) and then multiplying by 100. An IQ of 100 is considered to be average. (154)
- Intensity deafness.** Inability to hear faint sounds or, in more severe cases, loud sounds. (282)
- Interaction.** Influence by some other variable upon the effect of changing the independent variable. (29)
- Interneurons.** Nerve cells with many short dendrites and a short axon, the latter often giving off branches called collaterals; can connect a sense organ with many effector neurons and many muscles. (43; 46)
- Interval scale.** Scale of measurement in which equal differences between measurements stand for equal differences in the amount of the attribute which is being measured. (617)
- Intervening variable.** A logical construct to account for a process intervening between the variables controlled by the experimenter and the observed changes which take place in the dependent variable; this term is ordinarily applied only to logical constructs which are quantitative in nature or at least constant in form. (23)
- Introspection.** Technique of observing conscious processes and states, such as thinking and emotion, which go on within oneself. (20)
- Introversion.** Orientation toward the subjective, inner world of thought and feeling; the introvert tends to avoid social contacts. (124)
- Involuntary psychotic reaction.** Psychosis characterized by abnormal anxiety, agitation, delusion, and depression; occurs in later years, without previous history of psychosis; may be characterized chiefly by depression or can center around paranoid ideas. (485)
- IQ.** See *Intelligence quotient*.
- Iris.** Colored portion of the eye immediately surrounding the pupil; adjusts in size to regulate amount of light entering the eye. (260)
- Irradiation.** Mass action; the sluggish, irregular, widespread movement characteristic of the spontaneous movements of the fetus. (85) Process whereby, as more sensory fibers are activated by a stronger stimulus, more motoneurons are stimulated and a larger part of the body reacts. (50)
- Isolation.** Avoidance of conflict between two opposed desires or attitudes by keeping them apart in "logic-tight compartments" in consciousness. (474)

- Item analysis.** Method for determining the extent to which the responses to each item in a test differentiate between two groups. (152)
- James-Lange theory.** Theory that emotion consists of the bodily changes which occur in response to an exciting event, holding that we feel sad because we cry rather than vice versa. (427)
- Jump movements.** Series of short conjugate movements made by the eyes in looking at motionless objects. (262)
- Kinesthetic sense.** Sense of active movement. (287)
- Labyrinth.** Inner ear; contains cochlea, vestibule, and semicircular canals. (287)
- Labyrinthine sense.** Sense of passive movement. (287)
- Latent content.** Hidden content of a dream which indicates the individual's true wishes; changed to manifest content by dream work. (511)
- Latent learning.** See *Incidental learning*.
- Latent period.** Delay between the presentation of a stimulus and the beginning of a response; consists of time required for sensory nerve ending to be aroused, for impulse to be conducted through nerves, and for responding muscles to begin contracting; the more synapses involved, the longer the period. (51)
- Learning.** Process which brings about a change in the individual's way of responding as a result of contact with aspects of the environment. (181)
- Learning curve.** Graphic device for showing the amount or quality of a subject's performance after successive units of practice. (206)
- Learning set.** A readiness to respond in a certain way to a learning situation; learning how to learn. (244)
- Leniency error.** Tendency on the part of a judge to rate nearly all persons near the top of a rating scale; may be corrected by the use of forced-choice scales. (150)
- Lens.** Structure of the eye which focuses the light rays onto the sensitive retina. (259)
- Lesion.** A portion of the brain (or other tissue) destroyed by an experimenter, by accident, or by disease. (54)
- Libido.** In Freudian theory, the instinctive pleasure-seeking drive which is the source of energy underlying all human behavior. (120)
- Lie detector.** Collection of instruments to measure the intensity of visceral responses during questioning. (424)
- Life-history methods.** Techniques of psychological observation in which the development of particular forms of behavior is traced; include daybook method, clinical method, and biographical method. (24)
- Life style.** In Adlerian theory, the unique manner in which each individual strives for the basic goal of superiority. (124)
- Light adaptation.** Adjustment of the eye to light. (261)
- Limen.** Threshold. (257) See *Absolute limen* and *Difference limen*.
- Linear perspective.** Phenomenon of objects appearing both smaller and closer together as they become more distant. (316)
- Logic-tight compartments.** Form of intellectualization in which opposing desires or attitudes are "sealed off" in separate areas of consciousness; isolation. (474)
- Logical construct.** A quality, substance, or event whose existence is postulated by the experimenter as an aid in explaining how the independent variable operates on the dependent variable; sometimes called a *hypothetical construct*. (23)
- Logotherapy.** School of existential analysis which focuses upon the individual's need to see meaning in his life; emphasizes spiritual and ethical values. (512)
- Long-conducting neuron.** Nerve cell with a long axon or long dendrites; all sensory and motor fibers are of this type. (46)
- Longitudinal method.** Method of studying effects of age on various traits or abilities by testing and retesting (or otherwise observing) the same individuals over a period of time. (106)
- Lysergic acid diethylamide (LSD).** Drug capable of bringing on symptoms of mental disease in normal individuals; used legally in mental therapy only by medical prescription. (492; 533)
- Macro-factor.** A general factor such as socioeconomic status, as opposed to specific, more precisely defined micro-factors. (572)
- Malleus.** The first of three hinged bones in the ear which together transmit vibrations from the eardrum to the oval window; also called the hammer. (280)
- Manic-depressive reactions.** Psychotic reactions characterized by alternation between periods of extreme elation (manic episodes) and periods of extreme depression. (488)
- Manifest content.** Surface content of a dream, which we remember; masks the emotionally painful latent content. (511)
- Manipulandum.** In operant conditioning devices, a response mechanism which the subject must manipulate to obtain reinforcement. (493)
- Mass action.** Sluggish, irregular, widespread movement characteristic of the spontaneous movements of the fetus; also called *irradiation*. (85)
- Massed practice.** Use of concentrated learning periods. (231)
- Maturation.** Process of development and bodily change resulting from heredity acting over a period of time; independent of learning but may be hampered by a subnormal environment. (70)
- Mean.** Measure of central value, more familiarly known as the average; obtained by adding a group of measurements together and dividing the sum by the number of measurements; also called the *arithmetic mean*. (140; 619)
- Measurement.** Assigning numbers to persons, objects, or events according to certain rules. (137; 616)
- Median.** Measure of central value; the measurement which splits an ordered distribution exactly in half. (140; 619)
- Memory drum.** Instrument used in experiments on verbatim learning. (196)
- Memory span.** Amount of material which can be mastered from a single presentation; usually about six to eight digits or letters presented orally. (225)
- Mental age (MA).** Degree of mental development as

- measured by standardized intelligence tests; based on age at which average children make a given score; used in determining IQ. (153)
- Mental health movement.** Movement started by Clifford Beers shortly after 1900; seeks to create public awareness of the importance of psychological prophylaxis and psychotherapy. (501)
- Mental retardation.** Below-normal intelligence. Includes *mildly retarded* (IQ range from 50 to 70), *moderately retarded* (IQ 35 to 50), *severely retarded* (20 to 35), and *profoundly retarded* (below 20). (159)
- Mental telepathy.** Form of extrasensory perception involving the alleged passage of awareness from one mind to another without intervention of the sense organs. (332)
- Mescaline.** Drug which can bring on symptoms of mental illness; also used in therapy, primarily to induce regression to childhood experiences. (492; 533)
- Metabolism.** Chemical changes taking place in all living tissue by which energy is provided to carry on the life processes. (62)
- Metraxol.** Drug used for shock therapy, producing violent convulsions; seldom used today. (528)
- Micro-factor.** Relatively specific, precisely defined factor, as opposed to more general macro-factors. (572)
- "Middle man" hormones.** Secretions of the pituitary gland which act directly upon other endocrine glands to stimulate their functioning. (63)
- Milieu therapy.** Attempt to make the institution as a whole a therapeutic community for the mentally ill. (12)
- Mind-body problem.** Classical question of how the mind relates to the body. (5)
- Mode.** The measurement having the greatest frequency in a distribution; a measure of central value. (141; 618)
- Modes of appearance.** Characteristics of visual sensations other than those of hue, brightness, and saturation; include glow, luster, and bulk. (271)
- Monocular vision.** Sight with only one eye. (315)
- Monozygotic.** Developed from a single fertilized egg or zygote; refers to identical twins. (77)
- Mood.** An emotional state that is drawn out over a period of hours or days and is usually less intense than an "emotional outburst" such as anger. (451)
- Moron.** Former classification of individual with IQ from 50 to 70; now more often called *mildly retarded*. (159)
- Morphology.** Method of judging personality from physical appearance. (114)
- Motivational research.** Qualitative advertising research concerned with determining the underlying and presumably unconscious motives which cause people to buy certain products. (591)
- Motive.** Internal condition which serves to direct the organism toward a certain goal; a drive. (375)
- Motoneuron.** See *Efferent neuron*.
- Motor areas.** Areas of the brain involved in controlling body movements; primary motor area is in front of the fissure of Rolando and body surface is projected onto this area in reverse. Secondary motor area is near fissure of Sylvius, and *supplementary motor area* is in front of secondary area on midline of brain. (58; 59)
- Motor primacy.** The principle that the neuromuscular structures of the body must reach a certain stage of development (maturation) before they are capable of responding to stimulation. (82)
- Motor skill learning.** Learning in which performance involves primarily the use of the muscles. (197)
- Multiple factor theory.** Theory that the positive correlations typically found among intelligence tests are due to the fact that the tests measure several common factors. (162)
- Multiple personality.** Extreme dissociative reaction in which the individual develops two or more distinct personalities which alternate in consciousness, each personality being based on sets of motives which are in conflict with those of the others. (481)
- Muscle spindle.** Specialized group of muscle fibres wrapped with afferent nerve endings; involved in postural reflexes. (50)
- Myelin sheath.** Fatty white covering which surrounds the axons and collaterals of large diameter in the nervous system. (46)
- Myelination.** Process by which certain nerve axons become surrounded by the myelin sheath; necessary before they can function. (46)
- Myopia.** Near-sightedness, caused by the lens bulging out too far so that the image comes into focus slightly in front of the retina and appears fuzzy. (269)
- Narcoanalysis.** Brief form of narcosis in which sleep-producing drugs are administered in amounts sufficient to cause a state of "twilight sleep" rather than deep unconsciousness; while in this state, the patient is encouraged to talk about emotionally painful experiences. (529)
- Narcosis.** Technique of therapy which uses sleep-producing drugs; in prolonged narcosis, now used only for severely agitated patients, the patient may be kept asleep for fifteen or more hours a day for one or two weeks. (529)
- Need achievement score (n Ach).** A measure of the individual's motivation to achieve, obtained from a modified form of the Thematic Apperception Test; not a unitary factor. (132)
- Need-integrative therapy.** A brief form of psychotherapy which focuses on the basic present need that is behind the maladjustive behavior. (517)
- Negative afterensation.** Perception of a complementary hue after original stimulation ceases. (272)
- Negative transfer.** See *Proactive inhibition*.
- Nco-Freudians.** Modern psychoanalysts who believe that therapy must be aimed at understanding the patient's present situation as well as his unconscious processes and childhood experiences. (121; 512)
- Neonate.** Newborn infant. (88)
- Nerve.** Nerve trunk. (42)
- Nerve fiber.** Axon. (42)
- Nerve impulse.** Electrochemical excitation propagated along a chain of nerve cells. (46)
- Nerve tract.** Nerve pathway; bundle of nerve fibers which have a common place of origin and destination. (42)
- Nerve trunk.** Nerve; nerve tract connecting the central

- nervous system with other parts of the body. (42)
- Neurasthenia.** See *Asthenic reaction*.
- Neurologist.** Holder of an M.D. degree who specializes in the diagnosis and treatment of mental abnormalities caused by disease or injury to the brain and nervous system. (507)
- Neurology.** Study of the brain and nervous system and the diseases thereof. (9)
- Neuron.** Individual nerve cell. (42; 45)
- Neuropsychiatrist.** M.D. who specializes in the treatment of mental illnesses, including those caused by damage to the brain and nervous system. (507)
- Neurosecretion.** Formation of a hormone in the nuclei of neurons; occurs, for example, in the hypothalamus. (385)
- Neurosis.** Abnormal reaction pattern which lowers efficiency but seldom requires hospitalization; the neurotic usually retains contact with reality. (476)
- Noise.** In communication theory, random events that carry no meaning and interfere with communication. (370)
- Nonadism.** Withdrawal reaction in which the individual continually moves from place to place or job to job in an attempt to get away from frustrating situations. (470)
- Nominal scale.** Lowest scale of measurement, consisting only of classification; measurement on the nominal scale distinguishes between two or more mutually exclusive categories of persons, objects, or events, but imparts no quantitative information. (616)
- Nomothetic.** Approach to personality study which attempts to describe certain psychological elements presumed to be common to all individuals. (113)
- Nondirective therapy.** See *Client-centered therapy*.
- Noradrenaline.** Hormone secreted by the adrenal medulla during emotion; brings about a number of bodily changes, including constriction of the blood vessels near the body's surface. (64; 423)
- Normal distribution.** A mathematical model often used in psychology to describe the form of the distribution of measurements in a population; if the mean and standard deviation of a normal distribution are specified, it is completely described; it yields a symmetrical, bell-shaped curve with the greatest number of measurements concentrated around the mean, tapering off toward the extremes. (139; 629)
- Norms.** Standards derived from testing a large group of persons and used for comparing an individual's score with the scores of others in a defined group. (138)
- Nucleus.** Specialized protoplasm of a cell, important to cell physiology and reproduction. (45) A group of cell bodies located within the central nervous system. Cf. *Ganglion*. (42)
- Null hypothesis.** The hypothesis that is contradictory to the one which is to be tested; is rejected when the sample mean falls in the critical region. (632)
- Objective observation.** Observation of overt behavior and the conditions under which it occurs. (21)
- Objectivity.** In a test, the degree to which two or more persons can score a subject's responses and get the same results; more generally, freedom from bias. (138)
- Obsession.** Persistent and irrational idea, usually unpleasant, that comes into consciousness and cannot be banished voluntarily. (479)
- Obsessive-compulsive reaction.** An abnormal reaction characterized by the presence of anxiety, with persisting unwanted thoughts accompanied by the compulsion to repeat ritualistic acts over and over. (479)
- Occipital lobe.** Portion of the cerebrum located at the back of the brain; location of the visual center. (55)
- Old brain.** Portions of brain which developed first in evolution; comprises the cerebellum, the thalamus, and the hypothalamus. (43)
- Olfactory.** Pertaining to the sense of smell. (289)
- Olfactory area.** Anterior (front) portion of the rhinencephalon is associated with olfaction, as are parts of the hindbrain. (289)
- One-tailed test.** A test of statistical significance in which the critical region lies at one or the other extreme of the sampling distribution. (633)
- Operant behavior.** Behavior which is emitted by the organism and operates on the environment. (216)
- Operant conditioning.** Form of conditioning in which the organism becomes progressively more likely to respond in a given situation with that response which previously has brought a reward, such as a reward of food for pressing a lever. (186)
- Operational definition.** A definition of an abstract concept framed in terms of observable events or operations. (23)
- Opponent-process theory.** Theory of color vision which postulates three pairs of neural processes—yellow-blue, red-green, and white-black—each of which is capable of two modes of response that are opposed in nature. (275)
- Optic chiasma.** Point at which optic nerves leading from each retina form a partial cross at the base of the brain. (264)
- Optic nerve.** Nerve which carries impulses from the retina to the brain. (264)
- Oral period.** In psychoanalytic theory, stage of development when satisfactions center around sucking, biting, chewing, etc. (120)
- Ordinal scale.** Scale of measurement in which persons, objects, or events are ranked according to the amount of some attribute that they possess. (617)
- Organ of Corti.** Thickening of the basilar membrane at the floor of the cochlear duct; contains hair cells which are stimulated by motion of the fluid in the cochlear canals; impulses pass from nerve fibers associated with the hair cells to the auditory nerve and thence to the brain. (280)
- Organic psychosis.** Mental disorder resulting from injury to the nervous system or from such conditions as glandular deficiency or poisons. (490)
- Organism.** Living being composed of a group of interdependent organs which work together to carry on life activities. (39)
- Organismic theory.** Personality theory which stresses the orderly unfolding of the inherited potentialities of the organism and its unity; based on field theory. (125)
- Organs of adjustment.** Organs which function to help the individual adjust to his environment and overcome obstacles to the satisfaction of his needs. (40)

- Organs of maintenance. Organs (such as the heart, stomach, and lungs) which function to maintain the individual's health and growth. (40)
- Orienting reflex. Postural response in animals similar to the postural aspect of attention in humans. (296)
- Output. In cybernetics, the responses of a mechanism or organism. (342)
- Oval window. Membrane separating the middle from the inner ear; receives vibration from the hammer, anvil, and stirrup bones and in turn forces movement of the fluid in the cochlear canals. (280)
- Ovaries. Female gonads (sex glands). (64)
- Overcompensation. Extreme or socially unacceptable attempt to counterbalance actual or felt inferiority. (473)
- Overprotection. Encouragement of dependency in a child by shielding him too much. (505)
- Overt behavior. Activities which can be observed by an external observer. (7)
- Overtone. The fainter tones produced by the vibration of fractions of a vibrating wire or reed in a musical instrument and heard along with the fundamental tone; give a distinctive timbre to the sound of each instrument; also called *partials* or *harmonics*. (279)
- Oviduct. Tube leading from the ovary to the uterus, through which the mature egg travels. (390)
- Ovulation. Time when a mature egg cell is released down the oviduct to the uterus. (390)
- Ovum. Female gamete or germ cell. (74)
- Paired-associate learning. Learning in which the subject must respond with one word or syllable when presented with another word or syllable. (196)
- Pancreas. Endocrine gland which secretes the hormone insulin, which controls blood sugar level. (63)
- Paraconditioning. Occurrence during conditioning experiments of changes in behavior that do not qualify as conditioning but may easily be confused with true conditioning. (185)
- Paradoxical cold. Sensation of cold aroused by a warm object; obtained when cold-sensitive spots are stimulated by objects with a temperature above 110 degrees Fahrenheit. (287)
- Paradoxical warmth. Sensation of warmth obtained when warmth-sensitive spots are stimulated by objects with temperatures well below the psychological zero point. (287)
- Parameter. A number which represents a certain property of a population; is usually estimated from a statistic computed on a sample from the population. (628)
- Paranoia. Psychosis characterized by systematized, intricate delusions. (486)
- Parasympathetic division. Division of the autonomic nervous system which controls most of the vital functions of life, such as digestion; its action is antithetic to that of the sympathetic division in most cases; its nerves originate from the lower segments of the spinal cord and from the brain stem. Also called *cranio-sacral division*. (429)
- Parietal lobe. Portion of the cerebrum above the fissure of Sylvius and back of the fissure of Rolando. (55)
- Partial reinforcement. Reinforcement given only intermittently rather than regularly on every conditioning trial. (183)
- Partials. See *Overtone*s.
- Partiles. Points which divide a distribution of measurements into a number of equal parts. (143; 623)
- Perception. Process of becoming aware of events that stimulate the sense organs, and of determining the relationships among them. (300)
- Perceptual defense. Selective perceiving by which an individual unconsciously screens out perceptions which are unpleasant or threatening to him. (311)
- Performance test. Test in which muscular responses rather than verbal ones are required. (155)
- Peripheral nervous system. Nerve fibers passing from the receptors to the central nervous system or from the central nervous system to muscles and glands. (43)
- Peripheralist theories. Associationistic learning theories, which emphasize the importance of stimulation and reinforcement from the environment. (217)
- Person-oriented dependency. Dependence upon other persons for support, approval, affection, etc. (407)
- Personality. The whole person, including his external appearance and behavior (social stimulus value), his inner awareness of self as a permanent organizing force in his life, and his particular pattern of measurable traits. (111)
- Personnel psychology. Selection and classification of personnel and analysis of job structure; motivation and training of workers. (15)
- Phallic-Oedipal stage. In psychoanalytic theory, stage of development (between third and fifth year) when genital manipulation and exploration occurs and there is a strong attraction for the parent of the opposite sex, with jealousy toward the same-sexed parent. (121)
- Phenomenal field. In Rogerian personality theory, private world of individual experience. (125)
- Phobia. Irrational fear resulting from the displacement of free-floating fear onto some environmental object or situation other than the original cause of the fear. (478)
- Phobic reaction. Process of displacing free-floating fear onto some environmental object. (478)
- Phrenology. The false belief that the personality consists of "faculties," each located in a specific area of the brain, and evidenced through "bumps" on the skull. (115)
- Physical psychiatry. Use of drugs, shock therapy or other physical therapy by the psychiatrist, usually in order to prevent extreme acts or to make the patient more receptive to psychotherapy. (527)
- Physiognomy. An invalid method of judging personality from facial characteristics. (115)
- Physiological gradient. A line of decreasing intensity of reaction to stimulation, lying along the central vertical axis of the organism, with reaction being greatest at the head. Maturation follows the physiological gradient, proceeding from the head to the feet and from the center outward. (82)
- Physiological limit. Point beyond which further practice no longer improves performance. (209)
- Physiological sensitivity. Degree to which our sense organs are capable of responding to stimuli. (295)

- Pineal gland.** A small endocrine gland at the base of the brain, now thought to translate cyclic nervous activity generated by light into hormonal messages. (5; 63)
- Pitch.** Quality of sound produced by the frequency of the sound wave; expressed in cycles per second. (277)
- "Pitch is which" theory.** The place or resonance theory of hearing. (280)
- Pituitary gland.** The most important endocrine gland associated directly with growth; secretes pituitary growth hormone and a number of "middle man" hormones which act upon other endocrine glands. (63; 79)
- Pituitary growth hormone.** Secretion of the pituitary gland which controls the growth of the skeleton, muscles, and various internal organs. (79)
- Place theory.** A theory developed by Helmholtz, who maintained that the basilar membrane consisted of a series of resonating fibers that were tuned to different frequencies, with each vibrating membrane exciting a receptor cell located at the same place; main difficulty of the theory, which is no longer accepted, is that the basilar membrane does not consist of separate fibers. Also called *resonance theory*. (280) See also *Volley theory*.
- Placebo.** An inactive substance administered in such a way that the patient believes he is receiving an active drug. (29; 530)
- Placenta.** Organ which receives nourishment and oxygen from the mother's blood stream and passes waste materials from the fetal circulatory system back into the blood stream of the mother. Expelled after the baby is born (the afterbirth). (84)
- Plasticity.** Modifiability; one of the two basic but interacting characteristics of human and animal behavior. (375) See also *Energetics*.
- Plateau.** Period of no apparent learning, as measured by performance; appears as a flat place on a learning curve. (207)
- Point of indifference.** See *Psychological zero point*.
- Population.** Whole group in which a researcher is interested, from which samples are drawn for study. Also called *universe*. (626)
- Positive afterensation.** Sensation of the original hue after stimulation ceases. (273)
- Positive transfer.** See *Proactive facilitation*.
- Posthypnotic suggestion.** Suggestion, made by the operator during hypnosis, which becomes or remains active after the hypnotic session is over; usually effective only for a few days. (522)
- Predictor.** Item of available information used to predict future performance. (17)
- Predisposition.** Tendency or likelihood that certain symptoms will develop under given conditions; predispositions to certain psychoses are hereditary. (490)
- Prefrontal areas.** Forward part of the frontal lobes of the brain; concerned with the inhibition of certain kinds of emotion and the expression of others. (432)
- Prefrontal lobotomy.** Form of psychosurgery in which the nerve fibers connecting the hypothalamus with the prefrontal lobes of the brain are severed, the purpose being to cut intellectual processes off from the emotional processes which normally accompany them; used only with the most severe mental cases when all other forms of therapy have failed. (534)
- Prenatal.** Refers to entire period between conception and birth. (84)
- Prepotency.** Preeminence of certain kinds of stimuli over others in attracting attention. (297)
- Prepsychotic.** Term applied to borderline mental symptoms, difficult to diagnose as either psychotic or neurotic. (485)
- Presbyopia.** Condition of far-sightedness caused by a hardening of the lens which occurs with age. (269)
- Primary colors.** Colors which cannot be derived from any other colors but can, when mixed in different proportions, produce all other colors. The primary colors of light are red, green, and blue; those of pigment are red, yellow, and blue. (272). See also *Psychological primaries*.
- Primary mental abilities.** The relatively independent abilities, identified through factor analysis, which make up "general intelligence." Among them are verbal, spatial, numerical, and reasoning abilities. (161)
- Primary reinforcement.** Reward which directly satisfies some need of the organism. (184)
- Principle.** A general statement derived from a number of observed facts. (18)
- Privileged communication.** Freedom from being required to report to the authorities any information revealed by a client or patient concerning legal guilt; a right which clinical psychologists have in some states and are working to obtain in others. (507)
- Proactive facilitation.** The more ready learning of a new task because of prior learning of another task; also known as *positive transfer*. (227)
- Proactive inhibition.** Interference of a prior learning task with the learning and recall of a new task; also known as *negative transfer*. (228)
- Probability of response.** Criterion of learning often used for group learning; percentage of the group who make the correct response is the measure used. (205)
- Profile.** See *Psychograph*.
- Progesterone.** Female hormone secreted by the ovaries; produces changes in uterus tissues so that they can support fetal life. (81)
- Programed instruction.** Instruction in which material is presented in a sequence of steps, or frames, each ending with an item which the student must answer correctly before proceeding to the next. (237)
- Projection.** Defense mechanism by which the individual unconsciously convinces himself that others have the undesirable thoughts and motives which he actually has himself. (473)
- Projective techniques.** Methods of measuring personality traits in which the subject is presented with a standardized set of ambiguous or neutral stimuli and is allowed to interpret freely what he sees in them; also called *depth techniques*. (129)
- Prophylaxis.** Use of precautionary methods to prevent physical or mental illness. (503)
- Pseudoconditioning.** Phenomenon by which behavior similar to conditioned behavior is obtained without the typical pairing of stimuli which is the essence of true conditioning; usually reflects a heightened state of excitement in which the organism makes the same

- response to whatever stimulus is introduced. (185)
- Psychedelic drugs.** Drugs, such as LSD and mescaline, which temporarily produce symptoms of schizophrenia. (492)
- Psychiatric social worker.** The holder of a master's degree in social work who works with psychiatrists, psychologists, and other mental health workers, especially in providing data about the social aspects of a client's problem; often practices limited psychotherapy. (507)
- Psychiatrist.** Medical doctor who specializes in the diagnosis and treatment of mental disorders. (12; 507)
- Psychic trauma.** An experience in which emotional relationships bring pain; thought to lead to physical disorders such as cancer later in life. (439)
- Psychoanalysis.** School of psychology, originated by Freud, which emphasizes the study of unconscious mental processes; also a theory of personality and a method of psychotherapy which seeks to bring unconscious desires into consciousness and make it possible to resolve conflicts which usually date back to early childhood experiences. (8; 510)
- Psychoanalyst.** Therapist who uses the special system of theory and practice called psychoanalysis; required by organized psychoanalysts, though not by law, to have an M.D. degree. (507)
- Psychobiology.** Eclectic approach to therapy aimed at an understanding of all factors—biological, psychological, and social—involved in a disorder. (535)
- Psychodiagnosis.** Total study of an individual to determine his present psychological functioning in relation to past events and to predict the outcome of remedial measures. (12)
- Psychodrama.** Form of psychotherapy in which the patient acts out life situations that are related to his difficulties. (518)
- Psychogalvanic response.** See Galvanic skin response.
- Psychograph.** Chart showing an individual's standing on a group of objectively measured or rated traits; the traits are listed on one axis of the chart and the centiles or other values for each trait are marked at the appropriate points along the other axis, the points of individual being connected so as to show a profile of the individual's traits. (174)
- Psychological feedback.** Process whereby the individual gains information concerning the correctness of his previous responses in order to correct errors; knowledge of results. (229)
- Psychological motives.** Drives resulting from such needs as those for social approval, self-esteem, economic security, and greater knowledge; probably acquired as the result of experience. (377)
- Psychological primaries.** Red, yellow, green, and blue, so called because they appear psychologically irreducible. (270)
- Psychological selectivity.** See Attention.
- Psychological zero point.** Point at which neither warmth-sensitive spots nor cold-sensitive spots are stimulated; also known as point of indifference; usually about 90 degrees Fahrenheit. (287)
- Psychology.** Science of the behavior of organisms. (8)
- Psychometrist.** Specialist in psychological measurement. (15)
- Psychomotor abilities.** Abilities which require strength, coordination, and dexterity. (170)
- Psychopathic personality.** Personality characterized by inability to envision results of one's actions or to care about results; tends to be incapable of deep emotional feelings and indifferent to social customs and ethics; "moral imbecile." (579)
- Psychophysics.** A science concerned chiefly with determining the relationships between the physical qualities of stimuli and the sensations they produce; the direct forerunner of experimental psychology. (6)
- Psychosis.** Severe mental disorder characterized by personality disintegration and loss of contact with reality. (476)
- Psychosomatic disorder.** Physical symptoms, often including actual tissue damage, that may result from the continued mobilization of the body during a sustained emotional disturbance. (436)
- Psychosurgery.** Brain surgery used in the treatment of severe psychoses that have resisted all other known forms of treatment. (534)
- Psychotherapy.** A general term to describe treatment of personality and behavior disorders by psychological methods. (506)
- Pupil.** Opening in the iris of the eye through which light enters the eye. (260)
- Pupillary reflex.** Automatic contraction of the pupil of the eye in response to excessive light. (262)
- Pupillometrics.** Method of measuring changes in pupil size during emotion. The pupil of the eye dilates in response to stimuli which arouse a favorable reaction in the subject and contracts in response to distasteful stimuli. (425)
- Pure science.** Scientific study in which understanding is sought as an end in itself. (18)
- Purkinje effect.** Phenomenon experienced at nightfall, when the hues at the violet or short-wave end of the spectrum appear brighter than other colors; caused by the fact that during dark adaptation the eye loses sensitivity first to red and yellow and later to blue and green. (261)
- Pursuit movements.** Conjugate gliding movements made by the eyes in following moving objects. (262)
- Pursuit rotor.** Apparatus used in studies of motor learning; subject must keep the point of a hinged stylus in contact with a revolving brass target. (198)
- Pyriform cortex.** Layer of cortex on the underside of the temporal lobe which aids in control of sexual impulses; lesions cause extreme sexuality in animals. (434)
- Qualitative classification.** Grouping of items into categories on the basis of some characteristic which cannot be measured in a quantitative manner. (17)
- Quantitative classification.** Classification of items into categories on the basis of some characteristic which can be measured on a mathematical scale. (17)
- Quartiles.** Points which divide a distribution of measurements into quarters. (143)
- Radial motion.** Movement directly toward or away from the observer. (319)

- Random sampling.** Method of drawing a sample so that each member of the population has an equal chance of being selected, and so that the probability of each member being selected is independent of whether or not any other member is selected. (627)
- Randomization.** A form of experimental control in which subjects are assigned to experimental groups by chance or at random so as to eliminate any selective factor which might affect the results. (636)
- Range.** Simplest measure of variability; the difference between the highest and lowest measurements. (142; 621)
- Rapid eye movement (REM) sleep.** Type of sleep during which dreams occur. (330)
- Rating scale.** Device for recording the rater's judgment of himself or others on defined traits. On relative rating scales, the rater ranks the subjects in order from highest to lowest in the group on the trait in question. On absolute rating scales, the judge assigns an absolute value or score to the individual on each trait being rated. (149)
- Ratio scale.** Highest scale of measurement; has both equal units and an absolute zero; equal ratios between measurements stand for equal ratios of the amount of the attribute being measured. (617)
- Rational psychotherapy.** Form of brief psychotherapy developed by Albert Ellis, which encourages the patient to substitute rational for irrational ideas in the inner dialogue which he constantly holds with himself. (517)
- Rationalization.** Defense mechanism by which seemingly logical explanations are devised to explain and justify behavior which might otherwise result in loss of social approval and self-esteem; a form of intellectualization. (474)
- Raw score.** Numerical score obtained on a test; cannot be compared with scores from other tests until all have been converted into common terms. (139)
- Reaction formation.** Defense mechanism in which the individual's conscious attitudes and overt behavior patterns are the opposite of his unconscious wishes, which have been repressed. (472)
- Reaction time.** Time that elapses between a stimulus and an individual's response to it. (324)
- Recall.** Most widely used method of measuring retention; with a bare minimum of cues, subject must reproduce a response learned earlier. (210)
- Receptive field.** Area of retina from which impulses travel to a given neuron; always round for retinal ganglion cells, elongated for cortical cells. If center is excitatory, surround (periphery) is inhibitory and vice versa. (265-266)
- Receptors.** Structures in the nervous system which are sensitive to stimuli and set up nerve impulses in the sensory nerve fibers. (41; 257)
- Recessive gene.** Gene which is ineffective unless paired with another gene just like it. (76)
- Reciprocal inhibition.** Technique of psychotherapy developed by Wolpe in which the positive responses invoked in the patient-therapist relationship combine with, and then inhibit, the patient's anxiety responses; a modification of the use of conditioning in therapy. (513)
- Reciprocal innervation.** Process by which the excitation of one of an antagonistic pair of muscles is accompanied by the inhibition of the motoneurons supplying the other. (52)
- Recognition.** Method of measuring retention in which subject identifies previously learned items from among a list in which they are interspersed. (210)
- Reduction division.** Special kind of cell division which occurs in the development of the gametes, causing them to contain only half the number of chromosomes contained in other body cells. (75)
- Reflex.** Specific, automatic response involving only a part of the body, such as the knee jerk or the grasping reflex of an infant. (91)
- Reflex arc.** See *Sensory-motor arc*.
- Regression.** Defense mechanism in which the individual seeks to return to an earlier, more secure period of his life. (471)
- Reinforcement.** In classical conditioning, the process of following the conditioned stimulus by the unconditioned stimulus; in instrumental conditioning, the rewarding of the learner for adequate responses. In both cases, the response to a stimulus is strengthened. (183)
- Relative rating scale.** A method of rating in which each person's position on the scale is relative to that of other subjects in the group being considered. (149)
- Relatively refractory period.** Period during which a very strong stimulus is needed to produce a response in the nerve fiber; follows absolutely refractory period. (47)
- Relearning.** Most sensitive method of measuring retention; the subject relearns the original task under the original conditions, the difference in amount of practice needed to reach the original point of mastery providing the measure of retention. (210)
- Relevant variable.** A variable which might produce changes in the dependent variable and therefore must be controlled throughout the experiment. (27; 636)
- Reliability.** The degree to which people earn the same rank or score each time they take the same test or an equivalent but different form of it; the characteristic of a good measuring instrument. (136)
- Reminiscence.** Ability to remember a larger amount of incompletely mastered material at a later date than was recalled immediately after the cessation of practice. (212)
- Replication.** Repetition of an experiment under the same conditions to see if the same results are obtained. (26) In a factorial design, each of a number of representations of the same combination of independent variables. (642)
- Representative sample.** A group of individuals selected from a larger group in such a way that they accurately represent the characteristics of the larger group; essential for accurate results in an opinion poll or survey. (26)
- Repression.** Defense mechanism in which painful or guilt-producing thoughts, feelings, or memories are excluded from conscious awareness; such repressed material may remain active at an unconscious level, resulting in bizarre behavior. (468)
- Reserpine.** Tranquilizing drug widely used in the treat-

- ment of mental patients. (531)
- Resistance to extinction.** Criterion of learning based upon the persistence of a conditioned response during extinction trials. (205)
- Resistances.** In psychoanalysis, inability or unwillingness to discuss certain ideas, desires, or experiences during free association. (511)
- Resonance theory.** See *Place theory*.
- Respondent behavior.** Behavior which is elicited or evoked by events in the environment. (216)
- Response.** Any reaction, usually a muscular or glandular process, that depends upon stimulation. (40)
- Response generalization.** Use of a response similar to the correct one in conditioning. (184)
- Reticular formation.** Mass of neural nuclei and fibers in the brain stem just above the spinal cord; important in arousing and alerting the organism and also in controlling attention and perceptual discrimination. (36)
- Retina.** Inner layer of the eye, containing the light-sensitive rods and cones. (259)
- Retinal disparity.** The slight difference in the retinal image which the two eyes get from the same object; helps make depth perception possible. (315)
- Retroactive facilitation.** Greater ease of remembering caused by the nature of activity which intervenes between learning and recall. (249)
- Retroactive inhibition.** Greater difficulty of remembering caused by the nature of activity which intervenes between learning and recall. (249)
- Retrograde amnesia.** Loss of memory for events immediately prior to a blow on the head or an electroshock convulsion, with no impairment of more permanent memories; explained by two-stage memory process. (203)
- Retrograde degeneration.** Deterioration occurring in the nerve cell body when the long axon is cut; entire cell does not die. (45)
- Reward centers.** Clumps of cells in the brain, stimulation of which is sought by animals and inferred to give satisfaction. (435)
- Rhinencephalon.** Area in the brain stem consisting of primitive cortex and complicated subcortical structures which have both olfactory and emotional centers; oldest part of the cerebral hemispheres; the "nose brain." (56)
- Risky shift.** Tendency for a group to be willing to take greater risks than its individual members would take on their own. (552)
- RNA.** Ribonucleic acid, a cellular molecule similar in structure to DNA and regarded by some scientists as being responsible for encoding memory traces in the brain. (200)
- Rods.** Receptor cells of the retina capable of producing sensations of white, gray, and black but not of hues; effective in both day and night vision. (260)
- Rote learning.** Verbatim learning, without regard for meaning. (231)
- S-shaped curve.** Graphic representation of an entire learning process; indicates a period of increasing returns from practice during early trials, a period during which the rate of improvement remains constant, and finally a period of decreasing improvement. (207)
- Sacculi.** Saclike chamber in the vestibule at the base of the semicircular canals of the ear; contains receptors which respond to the static force of gravity and to straight-line motion. (287)
- Sample.** A group upon which measurements are taken; should be representative of some population or universe about which an inference is to be made. (587)
- Sampling distribution.** A distribution of statistics, each based on a sample. (631)
- Saturation.** Quality of color determined by the complexity of the light waves emanating from an object. More complex waves decrease the saturation, resulting in a grayish color. (270)
- Scapegoating.** Process of displacing aggression onto some object or person not the cause of the frustration. (464)
- Schemata.** Persistent, deep-rooted, well-organized classifications of situations and of kinds of behavior appropriate in those situations; influence our perceptions. (308)
- Schizophrenia.** Psychosis characterized by withdrawal from reality, emotional blunting and distortion, and disturbed thought processes. (485)
- Sclera.** Outer protective layer of the eye; sclerotic coat. (259)
- Score.** A number expressing quantitatively the results of a measurement. (17)
- Scotoma.** Temporary or permanent blind spot; may be caused by excessive use of tobacco or alcohol, by overexposure to light, or by certain diseases. (270)
- Secondary reinforcement.** Reward which, although it does not directly satisfy a need, has come to be satisfying in itself, usually because of previous association with primary reinforcements. (184)
- Self-actualization.** Man's constant striving to realize his full inherent potentials, regarded by Goldstein, Rogers, Maslow, and others as the most fundamental goal of the human personality. (125)
- Self concept.** The individual's awareness of his continuing identity as a person; develops gradually from an infant's discovery of the parts of his own body and comes to include all an individual's thoughts, feelings, attitudes, values, and aspirations. (125)
- Self-exciting circuit.** Arrangement of neurons whereby when one neuron discharges, the nerve impulse passes down the main axon into a collateral which connects with a second neuron which, in turn, transmits the impulse to the original cell, exciting it a second time. Self-exciting circuits make possible the prolongation of excitation. (49)
- Self-inventory.** Instrument for measuring personality traits by having the individual give information about himself; validity limited by subject's lack of self-understanding and by his desire to make himself appear better than he really is. (151)
- Semicircular canals.** Canals in the bony labyrinth of the inner ear forming three loops extending in three different planes; site of the labyrinthine receptors, which keep the organism informed of position and movement in space. (287)
- Semistarvation neurosis.** Psychological symptoms which appear as a result of prolonged periods on a markedly insufficient diet; characterized by apathy, depression,

- and irritability. (382)
- Sensitization.** Process by which emotional arousal increases general sensitivity so that a weaker stimulus than usual will elicit a response or a stronger response. (185)
- Sensory aphasia.** Inability to recognize spoken words; "word deafness"; can occur in persons who can hear simple sounds. (60)
- Sensory deprivation.** Minimal sensory stimulation, sometimes achieved by eliminating all visual and auditory stimulation as nearly as possible, sometimes by depriving subject of structured stimulation but using low-level meaningless stimulation; may lead to hallucinations and delusions. (328)
- Sensory feedback.** Information supplied by the senses when a response is made to a stimulus; this information, in turn, acts as a new stimulus. (41)
- Sensory-motor arc.** Functional unit of the nervous system; a chain containing a receptor neuron, one or more interneurons in the spinal cord or brain, and an effector neuron; also called a *reflex arc*. (41)
- Sensory neuron.** See *Afferent neuron*.
- Septal region.** Area of the brain along the dividing line between the two hemispheres, just below the front bend of the corpus callosum; active in control of rage and savageness. (434)
- Serial learning.** Learning in which the subject learns a series of words or syllables one at a time so that on successive showings he can anticipate the item that comes next. (196)
- Serial position effect.** Tendency for the early items in a series to be easier to recall than later items and for the last items to be easier to recall than the middle ones. (246)
- Servo control.** Use of external sources to maintain body temperature, as distinguished from the control maintained by internal homeostatic mechanisms. (388)
- Servomechanism.** Machine which is intrinsically purposeful or goal seeking. (341)
- Set.** Readiness to respond in a particular way to some stimulus situation for which there are a variety of possible responses. See also *Learning set*. (296)
- Shaping.** Form of instrumental conditioning used in training animals, in which all responses that come close to the desired one are rewarded at first, then only the closest approximations, until the desired response is attained; also called *successive approximation*. (188)
- Shock therapy.** Method of treating severe mental disturbances by inducing convulsions which are followed by a state of coma; usually induced by electricity. (527)
- Sibling.** Term used to indicate the relationship between any two children of the same parents. (77)
- Sigma.** Greek letter (σ) used as a symbol for one millisecond and also for one standard deviation. (324)
- Simultaneous brightness contrast.** Apparent change in gray to appear brighter (lighter) when seen next to black or darker when seen next to white. (272)
- Simultaneous hue contrast.** Apparent change in hue of gray to take on the complementary hue of the color seen next to the gray. (272)
- Size constancy.** Perceptual phenomenon by which we tend to perceive a known object as the same size regardless of its distance from us. (317)
- Skinner box.** Box containing a lever or other device which the animal must manipulate in order to obtain food or some other reward; used in experiments on operant conditioning. (187)
- Sleeper effect.** An increase in the effect of a propaganda communication over a period of time, contrary to the normal expectation that the message would be forgotten; may occur when source of propaganda is discounted, since the discounting factor tends to be forgotten more rapidly than the message. (608)
- Social facilitation.** Improvement of the performance of individuals by the mere presence of others. (551)
- Social perception.** Awareness of group attitudes; requisite of a good leader. (566)
- Social stimulus value.** The effect an individual has on others; includes his external appearance and his behavior toward others. (111)
- Social suggestion.** Tendency to pay attention to what is pointed out by others, or to perceive an object in the same way others perceive it. (312)
- Sociometric data.** Measures of social acceptance and interaction used in studying intragroup relationships; sociometric choices are choices made by group members of those they like or would prefer for specified roles or activities. (565)
- Sociotherapy.** Process of modifying the patient's environment in such a way that he will stand a good chance of making a successful adjustment. (537)
- Somatic nervous system.** Components of the nervous system which control the skeletal muscles; distinguished from the autonomic nervous system. (43; 428)
- Somatosensory areas.** Areas of cerebral cortex concerned with kinesthesia and the cutaneous senses; primary area lies just back of the fissure of Rolando and body surface is projected onto it; secondary area, just below, has the body projected on it less precisely and in reverse order. (288)
- Somatotype theory.** A body-type theory, proposed by Sheldon, relating physique to temperament and classifying individuals into three types: endomorph, mesomorph, and ectomorph. (116)
- Somesthesia.** Body sensation, including kinesthetic and cutaneous sensations, controlled by the somatosensory areas of the brain. (288)
- Spatial intelligence.** Space visualization; ability to visualize the relationships of objects in space; a primary mental ability. (169)
- Specific nerve energies.** Doctrine set forth by Johannes Müller which states that a sensory nerve will produce a certain type of experience no matter how it is stimulated. (58)
- Spectrum.** The range of wave lengths; the visible spectrum goes from violet at the short-wave end to red at the long-wave end. (270)
- Speed of response.** Criterion of learning based on number of responses made in a given time. (204)
- Sperm.** Male gamete or germ cell. (74)
- Spinal reflex action.** Simple stimulus-response behavior not ordinarily involving centers in the brain; can be studied by separating the spinal cord from higher centers.

- ters of correlation. (49)
- Split brain.** Brain in which the corpus callosum has been cut so that the two hemispheres are no longer connected; used in animal studies to learn more about brain functions. (61)
- Spontaneous potentials.** Rhythmic electrical oscillations which go on continuously in the cerebral cortex; not evoked by specific sensory stimuli. (339)
- Spontaneous recovery.** The return of a conditioned response following experimental extinction, after an interval of no stimulation. (183)
- Spreading cortical depression.** Reduction in electrical activity of the cerebral cortex induced by applying potassium to its surface through a hole bored in the skull. (668)
- Squint glasses.** Glasses composed of prisms; used in studying color vision. (318)
- Stage of exhaustion.** See *General-adaptation-syndrome*.
- Stage of resistance.** See *General-adaptation-syndrome*.
- Standard deviation.** A measure of variability; equal to the square root of the variance. (142; 621)
- Standard error.** A measure of how well a statistic represents a parameter; equal to the standard deviation of a sampling distribution. (631)
- Standard error of the mean.** A measure of how well a sample mean represents a population mean; equal to the standard deviation of the sampling distribution of means. (631)
- Standard score.** Score obtained by finding the difference between the raw score and the mean and dividing that difference by the standard deviation; useful in comparing scores on different tests. (143; 623)
- Standardization.** Process of obtaining norms, or standards, for comparing individual scores on a test; obtained by administering the test under standard conditions with standard instructions to a large group of persons who are representative of the individuals for whom the test is intended. (138)
- Standardized interview.** Interview in which predetermined questions are asked in a set order. (129)
- Stapes.** The last of three hinged bones in the ear which transmit vibrations from the eardrum to the oval window; also called the stirrup. (280)
- Statistic.** A number which represents a certain property of a series of measurements taken on a sample. (618)
- Statistical analysis.** Method used to identify the component abilities involved in complex tasks and skills. (31)
- Statistical control.** Technique of controlling variables mathematically rather than experimentally. (31; 641)
- Statistical inference.** Procedure of drawing general conclusions by studying samples. (626)
- Statistical significance.** The degree to which the outcome of an experiment is contradictory to the null hypothesis; the probability of obtaining a given experimental outcome if the null hypothesis is correct. (632)
- Stereotype.** Preconceived notion as to how people of a given race, nationality, or occupation appear or behave. (128)
- Stimulation method.** Method of determining which parts of the brain are related to muscular activity by stimulating areas of the brain and observing which muscles move. (54)
- Stimulus.** Energy given off by a stimulus object which, if strong enough, excites a receptor or group of receptors. (40; 257)
- Stimulus generalization.** Spread of a conditioned response to other objects similar to the original stimulus. (184)
- Stimulus objects.** The parts of the environment that cause an individual to react at any particular moment, or that are capable of making him react. (40)
- Stress.** Unpleasant emotional upheaval which the individual experiences in response to frustration; any adverse condition such as extreme cold, heat, loud noise, etc. (463)
- Stressor.** Anything injurious to the organism, either physically or psychologically. (440)
- Structuralists.** School of psychologists who studied conscious experience, conceived as made up of elementary mental states observable through introspection. (7)
- Subcortical structures.** Structures of the brain below the cerebral cortex and above the midbrain. (432)
- Sublimation.** Indirect expression of a need which cannot be satisfied directly, through acceptance of an alternate goal which provides a socially acceptable outlet of expression; usually refers specifically to indirect expressions of the sexual urge. (472)
- Subliminal.** Below the threshold; term applied to energy too weak to produce a response. (257)
- Substitution.** Expression of frustrated impulses indirectly but with no change in the conscious quality of the desire; often involves socially unacceptable activities. (472)
- Successive approximation.** See *Shaping*.
- Summation.** Production of a response by a combination of stimuli that, singly, are too weak to produce a response. *Temporal summation* is accomplished through the repetition of a weak stimulus; *spatial summation* through the simultaneous stimulation of two or more adjacent points. (52)
- Superego.** In psychoanalytic theory, that part of the personality which guards the ideas of right and wrong learned as a child; in constant conflict with the id; corresponds to the "conscience." (120)
- Survey method.** Obtaining data from a selected group by means of questionnaires or interviews. (26)
- Symbol.** An image, object, or activity that represents and can be substituted for something else. (335)
- Symbolic rewards.** Words or objects which cannot themselves satisfy biological drives but which come to be associated with primary rewards until they eventually acquire a reward value of their own. (401)
- Sympathetic division.** Division of the autonomic nervous system which is active in emergency conditions of extreme cold, violent effort or exercise, and states of fear or rage; fibers originate in spinal cord segments in middle of back. (428)
- Synapse.** Association, without direct contact, between the end brushes of one neuron and the dendrites of another. (48)
- Synaptic knob.** Rounded expansion at the end of each branch of the end brush of a neuron; comes very close to the next neuron and nerve impulse can

- "jump" across. (48)
- Synesthesia.** Translation of sensory experience from one sensory mode to another, as in seeing colors when sounds are heard. (314)
- Systematic desensitization.** Form of action therapy using the reciprocal inhibition technique; relaxation is induced while patient contemplates situations which produce anxiety; developed by Wolpe. (514)
- t ratio.** A ratio similar to a critical ratio except that it takes into account the size of the sample; used in null hypothesis testing. (634)
- Tachistoscope.** Apparatus which can project images or words onto a screen for a fraction of a second. (311)
- Tarantism.** A mass psychosis or "dancing mania" which occurred occasionally in Italy and Spain in the 17th century. (493)
- Taraxen.** A substance extracted from the blood of schizophrenic patients which, when injected into the blood of normal persons, will produce temporary psychotic symptoms. (491)
- Task-oriented dependency.** Dependence on others for the performance of certain tasks; decreases and is discouraged as child learns to feed and clothe himself and perform other developmental tasks. (407)
- Taste buds.** Clusters of receptors located on the tongue, responding to the four elemental qualities of taste—sweet, sour, salt, and bitter. (290)
- Tau effect.** Phenomenon by which the timing of stimulation of points on the surface of the body can influence the perceived distance between them; similar phenomenon exists in vision and hearing. If time between first and second stimulus is shorter than that between the second and third, the subject perceives the first two stimuli as closer together spatially than the second and third. (314)
- Telephone theory.** A frequency theory of hearing, according to which the basilar membrane plays the role of a telephone transmitter, relaying impulses of various frequencies to the brain; unacceptable because a single nerve fiber cannot respond fast enough to handle frequencies greater than 1000 cycles per second. (281)
- Temperament factors.** Traits of personality which describe the manner in which an individual characteristically operates. (147)
- Temporal lobe.** Portion of the cerebrum separated from the frontal and parietal lobes by the fissure of Sylvius and lying just beneath the temples. (55)
- Testes.** Male gonads (sex glands). (64)
- Testicular androgens.** Male sex hormones produced by the testes; the major hormones responsible for the development of masculine characteristics during adolescence. (81)
- Thalamus.** Structure almost in the center of the brain; relay station for incoming sensory messages from all parts of the body; responsible for sensations of pain and some diffuse, poorly localized sensations of pleasure or discomfort. (56; 288)
- Theory.** A logically organized set of principles propounded for the purpose of explaining a given group of phenomena. (18)
- Thinking.** The manipulation or organization of elements of the environment by means of symbols rather than overt activity. (335)
- Threshold.** See *Absolute limen* and *Difference limen*. (257)
- Throughput.** In cybernetics (as applied to man), activity within the nervous system which activates muscles to produce a response. (342)
- Thymus.** An endocrine gland, most active in early life, which plays a role in developing immunity. (63)
- Thyroids.** Endocrine glands located in the neck which affect body metabolism, influence intelligence, and help control the rate of physical growth. (64)
- Thyroxin.** Hormone secreted by the thyroids. (64)
- Timbre.** Quality of sound determined by the complexity of the sound wave, that is, by the number of overtones or partials which sound with the fundamental tone. (279)
- Tinnitus.** Ringing in the ears. (282)
- Tone deafness.** Inability to tell one note or pitch from another. (283)
- Trait.** Characteristic which can be observed or measured. (112)
- Tranquilizer.** Drug which calms and soothes the patient. (531)
- Transference.** Process by which a patient in psychoanalytic therapy attaches to the therapist feelings formerly held toward some person who figured in an emotional conflict, often a parent or a lover. (511)
- Transitional cortex.** A band of cortex running from the midline side of the frontal lobe across its underside and onto the temporal lobe; stimulation in this area produces visceral responses and vocalizations which are interpreted as emotional responses. (432)
- Trial and error.** Attempts to solve a problem by trying out alternative possibilities and discarding those that prove to be unsatisfactory. (353)
- Two-tailed test.** A test of statistical significance in which the critical region lies at both extremes of the sampling distribution. (633)
- Two-way analysis of variance.** Analysis of variance used in experiments in which there are two independent variables. (641)
- Two-way classification.** Classification of each subject in an experiment according to two independent variables. (641)
- Uncertainty principle.** Principle holding that measurements can never be absolutely accurate because an object or process may be altered by the very process of being measured. (22)
- Unconditioned response (UCR).** Response made to an unconditioned stimulus; often an inborn reflex, as in the case of salivation in response to food. (182)
- Unconditioned stimulus (UCS).** Stimulus which elicits a response in the absence of conditioning. (182)
- Unconscious mental processes.** Psychological processes or events which are below the level of consciousness (often as a result of repression) but which exert an important influence on the individual's behavior; first postulated by Freud. (8)
- Undoing.** Form of intellectualization in which the individual divests himself of painful feelings by making use of a cleansing ritual after some act which causes

- him to feel guilty; a defense mechanism. (474)
- Universe.** The ultimate group to which an inference is to be made from data drawn from a representative sample; also called *population*. (26; 626)
- Utricule.** Saclike chamber in the vestibule at the base of the semicircular canals of the ear, containing receptors which respond to the static force of gravity and to straight-line motion; important to our sense of passive movement. (287)
- Validity.** Extent to which a measuring instrument actually measures what it was designed to measure. (137)
- Variability.** Spread or deviation; often used as means of determining how far above or below the average of his fellows an individual is in a given trait; the most common measure of variability is the standard deviation. (140; 621)
- Variable.** Factor which may influence an experimental result; any measurable trait in which objects or people differ. (27)
- Variable interval schedule.** Schedule by which reinforcement is given after differing lengths of time, regardless of the number of correct responses made in between; leads to a relatively constant rate of response. (190)
- Variable ratio schedule.** Schedule by which reinforcement is given after a variable number of responses; leads to a high and constant rate of responding. (190)
- Variance.** A measure of variability which is computed by adding the square of the difference between each measurement and the mean, and dividing by the number of measurements; square of the standard deviation. (621)
- Ventromedial nucleus.** Area in the hypothalamus whose destruction causes savage behavior. (433)
- Verbal learning.** Any case of learning to respond to or with words. (196)
- Verbatim learning.** Word-for-word memorization. (196)
- Vigilance task.** Task which requires the detection of specified changes in the environment over extended periods of time. (327)
- Virilism.** Accentuation of masculine characteristics caused by overactivity of the adrenal cortex. (80)
- Visceral.** Pertaining to the internal organs; components of the nervous system which control the glands and the muscles of the internal organs. (428)
- Visual acuity.** Sharpness of vision. (259; 266)
- Visual area.** Occipital lobe of the brain, to which the optic nerves connect the two retinas. (264)
- Volley theory.** Auditory theory that nerve fibers operate in groups and that various fibers discharge their volleys of impulses at different times, making it possible for a bundle of fibers to reproduce high frequencies. Adequate for frequencies up to 5000, with a resonance (place) theory being needed to explain higher frequencies. The combination is known as the *place-volley theory*. (281)
- Wave length.** Linear distance from a point on one light wave or sound wave to the corresponding point on the next wave. Wave lengths of light are the physical stimuli for sensations of hue; wave lengths of sound are the stimuli for sensations of pitch. (269; 277)
- Weber's law.** Law stating that the difference threshold or smallest noticeable difference in perceived intensity is a constant proportion of the original stimulus. This law does not hold for extreme values. (258)
- Wernicke's center.** Area on cortex of temporal lobe below the auditory area, extending backward and curving up around the end of the fissure of Sylvius; its loss is associated with inability to understand spoken language. (60)
- Wisdom of the body.** Ability to choose proper foods according to needs of the body; evidenced in infants but largely undermined by acquired tastes in adults. (384)
- Withdrawal reactions.** Defense mechanisms involving physical flight or psychological withdrawal from the frustrating situation. (468)
- Within variance.** A measurement of variation based on variance within samples, which is the result of random variation in relevant variables. (636)
- Wrong-way impulses.** See *Centrifugal impulses*.
- X chromosome.** Sex-determining chromosome; female gametes always contain X chromosomes; if the offspring also obtains an X chromosome from its father it will be female. (77)
- Y chromosome.** Sex-determining chromosome found in half the total number of male gametes; uniting with the X chromosome always provided by the female gamete, produces male offspring. (77)
- Young-Helmholtz theory.** Theory that the human eye contains three kinds of cones, each sensitive to one of the three primary colors of light. (274)
- Zeigarnik effect.** Tendency to remember uncompleted tasks better than completed ones; tends to be reversed for tasks performed under stress produced by threat to the ego or self. (251)
- Zygote.** Cell formed by the union of the male and female gametes. (74)

Name Index

- A**
- Adam, G., 192
 Adams, Pauline, 221
 Adamson, R. E., 363, 365
 Adler, A., 123, 124, 476, 660
 Adolph, E. F., 385
 Adornetto, J., 312
 Agranoff, B. W., 668
 Ahmad, Farrukh Z., 408
 Akert, K., 202
 Aldrich, C., 324
 Alexander, B. K., 97
 Alexander, F., 436
 Alksue, J. F., 437
 Allport, F. H., 551
 Allport, G. W., 111, 145, 309, 343, 462, 681
 Alper, Thelma, 251, 252
 Altman, J. W., 14
 Amassian, V. E., 54
 Amassian, V. E., 291
 Ames, L. B., 91
 Ammons, R. B., 229
 Anastasi, Anne, 69, 101
 Anderson, B., 366
 Anderson, N. H., 606
 Anderson, R. L., Jr., 172
 Andersson, B., 385
 Ando, R., 576
 Andrews, J. P., 386
 Angel, C., 491
 Arenberg, D., 381
 Arey, L. B., 290
 Arima, R. K., 98
 Arkoff, A., 457
 Armilla, J., 569
 Arnold, W. J., 242
 Aronson, E., 602
 Arora, H. L., 653
 Asch, S. E., 560, 561
 Ashem, B., 515
 Ashley, W. R., 310, 311
 Atkinson, J. W., 132, 309, 311, 398
 Attardi, D. G., 653
 Austin, G. A., 351
 Axelrod, J., 5
- B**
- Baber, R. E., 453, 454
 Babich, F. R., 200
 Back, K. W., 562
 Bacon, F., 4
 Badger, D. H., 241
 Baer, D. M., 401, 408, 656
 Bagchi, B. K., 531
 Bailyn, Lotte, 681
 Bakhtiari, A. B., 529
 Baldora, L., 368
 Bandura, A., 405, 406, 407, 408, 409, 576
 Banham, Katharine M., 448, 452
 Barber, T. X., 342, 522
 Barch, A. M., 233
 Bard, P., 432
 Barker, J. P., 385
 Barmack, J. E., 34, 35
 Baron, J., 240
 Barondes, S., 668
 Barr, M. L., 77
 Barry, H., 389
 Barry, J. R., 176, 410
 Bartlett, F., 357
 Bartlett, N. R., 267
 Bartlett, Susan C., 338
 Bash, K. W., 379
 Bass, B. M., 151, 553, 569
 Bateman, D., 242
 Bateson, G., 404
 Batini, C., 56
 Bauer, R. A., 681
 Baumeister, A., 326
 Bavelas, A., 571
 Bayley, Nancy, 108, 446
 Beach, F. A., 390
 Beadle, G. W., 75
 Bealer, R. C., 454
 Becker, F. C., 205
 Beers, C. W., 501
 Beidler, L. M., 291
 Békésy, G. von., 280
 Bell, E. C., 533
 Bell, G. B., 567, 570
 Bellows, R. T., 385
 Benaron, H. B., 386
 Bender, G. W., 454
 Bendig, A. W., 169
 Benedict, Ruth, 544
 Benjamin, R. M., 292
 Bennett, I. F., 532
 Benson, P., 456
 Bentzen, C., 403
 Berg, I. A., 479
 Berger, H., 339
 Bergler, E., 497
 Bergson, H., 375
 Berkowitz, L., 577
 Berlyne, D. E., 656
 Bernard, J., 86
 Berry, P. C., 552
 Bersh, P. J., 183
 Bettelheim, B., 475
 Bevan, W., 115
 Bhatt, J., 212
 Biderman, A. D., 613
 Bigelow, J., 341
 Bilodeau, E. A., 231
 Bilodeau, Ina, 231
 Binet, A., 153
 Birch, H. G., 365
 Birch, J. W., 158
 Blake, R. R., 551
 Blandford, D. H., 198
 Blaylock, Barbara, 457
 Blewett, D. B., 167
 Bloch, H. A., 497
 Block, C. H., 552
 Blosser, D., 206
 Blum, J. M., 555
 Blum, M. L., 32
 Boardman, W. K., 324
 Bobbitt, Ruth A., 98
 Bogartz, W., 366, 368
 Bogoraz, V. G., 311
 Boileau, V. K., 517
 Bolinger, R. W., 133
 Bolles, R., 384
 Boring, E. G., 269, 375, 648
 Börnstein, W., 291, 292, 314
 Boshes, B., 386
 Bosselman, B. C., 487
 Bousfield, W. A., 82
 Bowman, P. H., 383
 Bowlby, J., 659
 Bradway, Katherine P., 107
 Brady, J. V., 434, 437, 656
 Branch, C. H. H., 502
 Brandt, H. F., 262
 Brant, D. H., 398
 Braun, H. W., 227, 250
 Bray, C. W., 230, 231, 281
 Brayfield, A. H., 15
 Brecher, G. A., 269
 Breecher, H. K., 285
 Breedlove, J., 457
 Breesee, Fay H., 169
 Breger, L., 368
 Bregman, E. O., 445
 Brekstad, A., 129
 Bressler, M., 681
 Bridger, W. H., 184
 Bridges, K. M. B., 447
 Briggs, L. J., 211
 Brill, H., 533
 Brill, L., 497
 Brim, O. C., Jr., 14
 Brink, J. J., 668
 Broadbent, D. E., 654, 674
 Broca, P., 6, 60
 Brodeur, D. W., 531
 Brogden, H. E., 172
 Brogden, W. J., 184, 185, 326
 Bromley, D. B., 246
 Bronner, A. F., 576, 578, 580
 Brooks, L. O., 366, 368
 Brookshire, K. H., 204
 Brown, H. M., Jr., 186
 Brown, I. D., 411
 Brown, J. S., 229
 Brown, M., 407
 Brózek, J., 379, 383, 534
 Bruce, R. W., 229
 Bruner, J. S., 9, 308, 310, 347, 351
 Brunish, R., 436
 Brunswick, E., 663
 Bryan, Judith F., 412
 Bryan, W. L., 207, 208
 Bubash, S., 200
 Buchanan, W., 601
 Buck, C., 200
 Buckner, D. N., 327, 328
 Bucy, P. C., 434
 Bugental, J. F. T., 12
 Bühler, Charlotte, 338
 Bulin, G. V., Jr., 87
 Bunch, M. E., 206, 243, 375
 Burger, O. K., 425
 Burgess, E. W., 455
 Burke, C. J., 425
 Burke, Mary Long, 227
 Burley, L. R., 172
 Burnstein, E., 558
 Bush, R. R., 218
 Buss, A. H., 401, 404
 Buswell, G. T., 262
 Butler, R. A., 397
 Butler, R. N., 532
 Buittenwieser, P., 455, 456
 Buxton, C. E., 213

Byers, L. W., 491
Byers, S. O., 656
Byrne, D., 457

C

Caffey, E. M., Jr., 532
Cain, L. F., 211
Calahan, D., 588
Calkins, M. W., 244
Calvin, A. D., 401-402
Campbell, B. A., 382
Campbell, J., 552
Canfield, A. A., 325, 327
Cannon, W. B., 378, 379, 440, 441
Cant, G., 536
Carey, F. M., 200
Carlisle, H. J., 388, 389
Carlsmith, J. M., 602
Carlson, A. J., 379
Carmichael, L., 72, 83, 84, 86, 344
Carpenter, J. A., 494
Carroll, J. B., 227
Carterette, E. C., 321
Caruth, C. J., 402
Casey, J. F., 532
Cason, H., 452
Castaneda, A., 224
Castiglione, L., 456
Catalano, F. L., 93
Cattell, J., 7
Cattell, R. B., 137, 146, 147, 176, 534, 566
Cavanaugh, E. B., 656
Champion, R. A., 376
Chancellor, L. E., 454
Chandler, K. A., 314
Chapanis, A., 270, 274, 361
Chapanis, Natalia P., 361
Charles, D. C., 161
Chave, S., 504
Cheek, Frances E., 492
Chernikoff, R., 326
Childs, I. L., 116
Chiles, W. D., 388
Choo, Tong-He, 602
Chow, K. L., 96
Chowdhry, K., 567
Christensen, H. T., 456
Christensen, P. R., 362
Cibelli, L. A., 532
Clark, R. A., 132, 311, 398
Clark, R. E., 387
Clarke, R. S., 97
Clauser, G., 531
Cleckley, H. A., 483
Clemente, C. D., 389
Coch, L., 559
Cofer, C. N., 226, 355
Cohen, A. R., 286, 600

Cohen, H. D., 668
Cohen, J., 322, 323, 344, 386
Cohen, M., 491
Cohen Melvin, 456
Cohen, S., 533
Cole, Nyla J., 502
Coleman, J. C., 485, 497, 498, 505
Coleman, P. D., 203
Commins, W. D., 222
Comrey, A. L., 325, 327
Conger, J. J., 436
Conklin, E. G., 74
Conrad, H. S., 105, 106
Conrad, I. G., 457
Cook, E. H., 267
Cook, T. W., 232
Cooper, E., 597
Cooper, J. B., 425
Cooper, L. F., 240
Cornsweet, J. C., 263
Cornsweet, T. N., 263
Corsini, R. J., 106, 456
Coser, L. A., 678
Cottrell, L. S., 455, 574, 576
Cowan, P. A., 407
Cowan, R. C., 537
Cowen, E. L., 365
Cowey, A., 191
Cowlies, J. T., 400
Cozan, L. W., 591
Craig, W. W., 195
Crane, A. R., 450
Crannell, C. W., 173, 226
Crawford, J. D., 63
Crawford, M. P., 545
Crespi, L. P., 208
Cressey, D. R., 577, 578, 579-580
Crick, F., 74
Cronbach, L. J., 131
Cruze, W. W., 72, 73
Cuadra, C. A., 579
Culler, E. A., 185, 189, 201
Cushman, J. F., 495

D

Dallenbach, K. M., 249
Dallin, L., 238
Dalton, J., 275
Darwin, C., 7
Davidson, D., 360
Davis, C. M., 384
Davis, J. F., 377
Davis, J. M., 502
Davis, R. C., 379, 394, 425
Davis, R. E., 668
Davis, R. T., 242
Davis, W. A., 168

Dean, S. J., 241
Dederich, C. E., 497
de Groot, J., 389
Deininger, R. L., 225
Delgado, J. M. R., 435
Dement, W. C., 330, 331
de Mille, R., 535
Denenberg, V. H., 92
DeNike, L. D., 241
Dennis, W., 73, 103, 545
Dent, R. W., 214
Descartes, R., 5
Desson, C. H., 529
Deter, C. W., 242
Detwiler, S. R., 259
Deutsch, A., 533
Deutsch, M., 545
Dewey, J., 6, 7, 355
DeWolfe, A. S., 605
Diamond, L. S., 532
Dice, Nanette, 531
Dickson, W. J., 30
Dienes, Z., 359
Dignam, J. M., 234
Dimmick, F. L., 270
Dinitz, S., 579
Ditman, K. S., 533
Di Vesta, F. J., 601
Dollard, J., 127, 400
Dowis, J. L., 485
Dowling, R. M., 227, 250
Drake, R. M., 168
Dreikurs, R., 519
DuBois, P. H., 243
Duffy, M., 350, 381
Dukes, W. F., 115
Dulany, D. E., Jr., 241, 401
Dunbar, F., 33
Duncan, C. P., 203, 228, 667
Duncanson, J. P., 243
Duncker, K., 363
Dunham, W. H., 577
Dunnette, M. D., 411, 552, 585, 588
Durant, W. J., 4
Duvall, H. J., 497
Dworkin, L., 240, 286
Dwornicka, B., 86

E

Eagly, Alice H., 603
Eaton, J. W., 504
Ebaugh, F. G., 478, 484, 488
Ebbinghaus, H., 196, 211, 214, 226
Eccles, J. C., 653
Edwards, A. L., 396
Edwards, W., 360
Egstrom, G. H., 235

Eisen, N. H., 95
Eisenman, J. S., 654
Eisenson, Joan, 290
Eisner, B. G., 533
Elkind, D., 346
Elliott, F. R., 325
Ellis, A., 518, 525
Ellison, G. O., 170
Ellson, D. C., 425
Emmons, W. H., 242
Engen, T., 89
English, Ava C., 111
English, H. B., 111
Epstein, A. N., 380
Epstein, L., 118
Erickson, C. W., 224, 451
Erickson, S. C., 232
Erickson, M. H., 251, 577
Erikson, E. H., 121, 122-123, 662
Espenshade, A., 79
Estes, Betsy, 168
Estes, W. K., 205, 218
Evans, R. M., 273
Evarts, E. V., 532
Ewen, R. B., 553
Ewing, T. N., 597
Eysenck, H. J., 146, 147, 524

F

Fadiman, J., 533
Fagin, B., 222
Fairbanks, G., 341
Fairweather, C. W., 525
Fanning, Rita, 532
Fantel, E., 519
Fantz, R. L., 89-90
Farber, I. E., 612
Farberow, N. L., 464, 465
Farnsworth, D., 276
Fassett, Katherine K., 106
Fatherson, Hanna F., 119
Faust, W. L., 551
Fearing, F., 345
Fechner, G. T., 6
Feigley, C. A., 491
Feinberg, M. R., 14
Feld, S., 506
Fenichel, O., 474
Ferguson, C. K., 547
Ferguson, L. W., 455, 456
Ferriman, M. R., 133
Feshbach, S., 421, 422
Festinger, L., 30, 361, 462, 606
Fex, J., 296
Fiedler, F. E., 568, 570
Fields, P. E., 192
Filer, R. J., 323
Filmer-Bennett, G., 131

- Finch, G., 189
 Finckle, L. P., 534
 Fine, B. J., 605
 Fine, R., 22, 344
 Fink, M., 532
 Finney, J. C., 505
 Firestone, I., 286
 Fisher, R., 678
 Fischelli, V. R., 290
 Fitts, P. M., 327, 675
 Fleishman, E. A., 170
 Fletcher, J. L., 283
 Flexner, J. B., 200
 Flexner, L. B., 200
 Fluckiger, F. A., 118
 Fode, K. L., 651
 Foltz, E. L., 437
 Forbes, A., 201
 Forbes, T. R., 390
 Foreman, Sally, 231
 Forgas, R. H., 237
 Foucault, M., 501
 Fox, B. H., 242
 Fracker, C. C., 173
 Frank, T. V., 532
 Fraser, J. A., 323
 Freedman, J. L., 610
 Freeman, F. N., 165
 Freeman, G. L., 299
 Freeman, W. J., 534, 535
 French, J. D., 656
 French, J. R. P., Jr., 545, 559
 French, R. L., 570
 Freud, Anna, 475
 Freud, S., 8, 120-121, 660-661
 Frey, M. von, 6
 Frick, J. W., 362
 Friedman, M., 439, 656
 Friedman, M. P., 321
 Fromm, E., 121, 122
 Frunkin, R. M., 456
 Fulkerson, S. C., 176
 Fulton, J. F., 432
- G**
- Gaddum, J. H., 653
 Gagné, R. M., 245
 Calambos, R., 297
 Galanter, E. H., 567
 Galbraith, Dorothy, 117
 Gallup, G., 597
 Galton, F., 342
 Canuli, H. C., 410
 Garafolo, L., 379
 Garai, J. E., 598
 Gates, A. I., 169, 236
 Gates, C. S., 222
 Gay, Patricia, 434
 Gebel, A. S., 569
- Geber, Marcelle, 99
 Gebhard, M. E., 525
 Gebhard, P. H., 390
 Geen, R. G., 577
 Gellermann, L. W., 338
 Gentry, J. T., 87
 Gerjov, Irma R., 401
 Gesell, A., 98, 100
 Gestring, G. F., 297
 Getzels, J. W., 367
 Gewirtz, J. L., 400, 401, 656
 Ghiselli, E. E., 553
 Gibbs, C. B., 411
 Gibson, Eleanor, 98, 99, 302
 Giffen, M. B., 133
 Gilbert, G. M., 251
 Gilchrist, J. C., 566
 Gille, R., 169
 Glenn, E. S., 307
 Glueck, Eleanor T., 575, 576, 578, 580
 Glueck, S., 575, 576, 578, 580
 Godfrey, J., 313
 Goldberg, S. C., 566
 Goldfarb, W., 87, 95
 Goldfrank, E. D., 544
 Goldiamond, I., 514
 Goldman, I., 544
 Goldstein, A. P., 532
 Goldstein, H., 533
 Goldstein, K., 125, 314
 Goldstein, L., 492
 Goldstein, M. J., 606
 Goldstone, S., 324
 Collin, E. S., 349
 Goode, W. J., 435
 Goodenough, Florence L., 118
 Goodman, C. C., 310
 Goodner, C. J., 379
 Goodnow, J. J., 351
 Gordon, M. H., 532
 Gordon, T., 563
 Goren, C. H., 239
 Gottier, R. F., 152
 Gottlieb, C., 195
 Gough, H. C., 476, 579
 Gourtivitch, C., 191
 Governale, Catherine N., 605
 Gowing, J., 329
 Graham, D., 410
 Grant, J. D., 661
 Grant, Marguerite Q., 661
 Grasberger, J. C., 532
 Gray, P. H., 446
 Gray, Susan, 166
 Green, J. D., 389
 Green, Leah Ann, 368
 Greenberg, A., 233
 Greenblatt, M., 533
- Greene, W. A., 439
 Greening, T., 12
 Greenspoon, J., 231, 401
 Greer, P. L., 567
 Gregg, L. W., 326
 Gregory, I., 575
 Gregory, S. C., Jr., 243
 Grether, W. F., 185
 Griew, S., 247
 Grimshaw, L., 480
 Grings, W. W., 228, 326
 Grinker, R. G., 529
 Gross, C. R., 200
 Grossack, M. M., 547
 Grosser, G. H., 533
 Crosslight, J. H., 189
 Grossman, M. I., 380
 Grossman, S. P., 54, 653
 Grota, L. J., 92
 Gruen, W., 520
 Gruenberg, E. M., 504
 Guetzkow, H. S., 383, 534
 Guilford, J. P., 17, 132, 146, 147, 149, 163-165, 171, 284, 357, 362, 398
 Guion, R. M., 152
 Gumeson, G. G., 368
 Gunn, C. C., 656
 Gurin, G., 506
 Gustafson, L. A., 428
 Guthrie, E. R., 216
 Guttman, N., 341
- H**
- Hack, M. A., 191
 Hagbarth, K. E., 296
 Haggard, E. A., 661
 Haggard, E. E., 129
 Haggerty, R. J., 438
 Haire, M., 308, 592
 Halas, E. S., 186
 Hall, E. J., 551
 Hall, E. R., 553
 Hall, H. E., Jr., 567
 Hall, J. F., 189
 Hall, K. R. L., 285, 392
 Halliday, J. S., 436
 Halverson, H. M., 91
 Hamblin, R. L., 546
 Hamilton, Madge, 456
 Hamilton, M., 532
 Hammel, H. T., 654
 Harabedian, A., 327, 328
 Harding, H. F., 366
 Hardy, J. D., 388, 654
 Hardy, K. R., 391
 Hare, A. P., 606
 Hare, R. D., 579
 Harlow, H. F., 97, 244, 245, 338, 392, 393, 397, 433, 612, 656
- Harlow, M. K., 397
 Harman, H. H., 172
 Harman, W., 533
 Harmon, F. S., 299
 Harper, F. F. B., 562
 Harper, R. A., 513
 Harper, R. S., 310, 311
 Harrell, M. S., 157
 Harrell, Ruth F., 169
 Hartell, T. W., 157, 570
 Hartman, A. E., 384
 Harris, D. H., 274
 Harris, G. W., 659
 Harris, H., 568, 569
 Harrison, R., 132
 Harrower, M., 16, 534
 Harter, N., 207, 208
 Hartford, H., 118
 Hartman, A. P., 269
 Hartmann, H., 661
 Harton, J. J., 323
 Hartup, W. W., 408
 Harvey, O. J., 661
 Hathaway, S. R., 465, 534, 578
 Havighurst, R. J., 101, 102, 168, 169, 661
 Hawkins, J. E., Jr., 191
 Hawkins, W. F., 326
 Healy, W., 576, 578, 580
 Heath, R. C., 491
 Heathers, C., 408
 Hebb, D. O., 44, 95, 96, 202, 377
 Hecht, S., 261
 Heese, K. W., 243
 Heider, F., 683
 Heinemann, Shirley, 228
 Helmholz, von H., 6, 274, 280
 Helson, H., 314
 Hendin, H., 466
 Henry, A. F., 440
 Henry, F., 326
 Henry, L. K., 231
 Henschel, A., 379, 383
 Heriot, J. T., 203
 Herman, D. T., 313
 Herman, L., 532
 Hernández-Péon, R., 296
 Heron, H., 97
 Heron, W., 330, 607
 Hersey, R. B., 300
 Hershenson, M., 90
 Herzog, Herta, 592
 Hess, E. H., 193, 194, 425-426
 Hetzer, Hildegard, 338
 Heuyer, C., 169
 Hewer, V. H., 409
 Heyer, A. W., Jr., 385
 Hiesinger, L., 241
 Highmore, G., 172

Hilgard, E. R., 73, 225, 228
 Hilgard, J. R., 493
 Hill, L. B., 214
 Hirsch, J., 69, 76
 Hirt, Z. I., 161
 Hoagland, H., 322
 Hobbs, G. E., M.D., 33
 Hobson, J. R., 169
 Hoepfner, R., 17
 Hoffman, A. C., 387
 Hoffman, L. R., 553
 Hogan, H. P., 344
 Hojier, H., 345
 Holland, J., 200
 Holland, J. L., 525
 Hollander, E. P., 566, 568, 569
 Hollister, L. E., 532
 Holloway, H., 492
 Holmes, T. H., 438, 439
 Holzinger, K. J., 165
 Honigfeld, G., 492
 Hood, A. B., 117
 Hooker, D., 84
 Hoover, J. E., 581
 Horney, Karen, 121-122
 Horsley, J. S., 529
 Horvath, C., 290
 Hovland, C. I., 237, 246, 464, 599, 600, 608
 Howard, J., 468
 Howard, K. I., 131
 Howard, P. J., 169
 Howard, V. M., 173
 Hoy, Patricia A., 385
 Hoyt, W. G., 242
 Hubbard, M. R., 270
 Hubel, D. H., 266, 275, 652
 Hudson, B. B., 387
 Hudson, W., 309
 Hull, C., 215, 216
 Hull, C. L., 226, 351
 Hunt, D. E., 661
 Hunter, W. S., 337, 338
 Huntoon, Mary, 521
 Hurlock, Elizabeth B., 450, 545
 Hurvich, L. M., 275
 Husband, R. W., 73, 235, 243, 313
 Husek, T. R., 601
 Husen, T., 167
 Huston, Aletha C., 405
 Hyman, R., 366, 381
 Hymovitch, B., 98

I

Ilg, F. L., 91
 Irvine, R. P., 228
 Irwin, O. C., 93
 Isaacs, K. S., 417, 661

Isaacs, W., 514
 Iscoe, I., 492
 Israel, R. H., 533
 Ittelson, W. H., 319
 Iverson, M. A., 557
 Ivy, A. C., 379
 Iwahara, S., 457

J

Jaastad, Kay, 552
 Jackson, O. P., 327
 Jackson, P. W., 367
 Jacobsen, C. F., 202
 Jacobson, Ann, 200
 Jacobson, A. H., 457
 Jacobson, A. L., 186, 200
 Jacobson, E., 340
 Jacobson, H., 673
 Jacobson, J. H., 297
 Jacobson, Lenore, 651
 Jahoda, M., 597
 James, R. L., 186
 James, T., 416
 James, W., 7, 88, 426, 446
 Jameson, Dorothea, 275
 Janis, I. L., 441, 599, 607, 610
 Janowitz, H. D., 379, 380
 Jarvik, M. E., 668
 Jasienska, A., 86
 Jeeves, M., 359
 Jenkins, J. C., 222, 249, 586
 Jenkins, R. L., 514
 Jensen, G. D., 98
 Jensen, M. B., 568
 Jerison, H. J., 328
 Johnson, D. M., 351, 361
 Johnson, N. A., 533
 Johnson, T., 200
 Johnson, W. B., 455, 456
 Jones, B. E., 232
 Jones, D. S., 578, 579
 Jones, H. E., 79, 105, 106, 446
 Jones, L. C. T., 224
 Jones, L. V., 225
 Jones, M. C., 262, 446
 Jones, R. E., 327, 675
 Jones, Susan, 605
 Jouvét, M., 296
 Jung, C., 123-124
 Jurgensen, C. E., 410

K

Kaada, B. R., 434
 Kagan, J., 131, 132
 Kahn, E., 331
 Kahn, T. C., 133

Kallmann, F. J., 490
 Kaplan, B., 404
 Kaplan, S. J., 225
 Karelitz, S., 93
 Karowski, T. P., 314
 Katz, D., 118
 Katz, I., 456
 Katzell, R. A., 13
 Kavanau, J. L., 398
 Kaye, D., 607
 Kaye, H., 89
 Kellas, C., 326
 Keller, E. D., 408
 Keller, F. S., 208
 Kelley, H. H., 547, 556
 Kelley, H. P., 243
 Kellogg, W., 278
 Kelly, E. L., 457
 Kelman, H. C., 600, 603, 677-684

Kendler, H. H., 218, 233
 Kendler, Tracy S., 218
 Kennedy, J. F., 159
 Kennedy, W. A., 404
 Kenney, Helen, 347
 Kessen, Marion L., 381
 Kessen, W., 83, 90
 Keys, A., 379, 383, 534
 Kilpatrick, F. P., 300
 Kimble, D. P., 186
 Kimble, Priscilla F., 276
 Kimmel, H. D., 228
 Kimura, K., 291
 King, F. A., 434
 King, H. E., 259
 King, R. A., 203
 King, S. H., 440
 King, S. M., 314
 Kinsey, A. C., 390
 Kirchner, W. K., 145, 247, 585
 Kirschner, P., 607
 Kittell, J. E., 237
 Klaus, R. A., 166
 Klebanoff, S. G., 12, 535
 Klein, D. F., 532
 Klein, H., 531
 Klein, P., 582
 Kleitman, H., 387
 Kleitman, N., 327, 386
 Klett, C. J., 532, 535
 Kline, N. S., 531
 Klineberg, O., 565, 574
 Kling, A., 434
 Klüver, H., 434
 Knapp, P., 427
 Knickerbocker, I., 563
 Knutson, C. S., 186
 Koffka, K., 217
 Kogan, N., 552
 Kohlberg, L., 661
 Kohler, I., 318
 Köhler, W., 40, 217, 354

Kolesnik, P. E., 274
 Koltuv, Barbara B., 129
 Komarovskiy, M., 453
 Korchin, S. J., 225, 252
 Koteen, H., 532
 Kraines, G. H., 478
 Kramer, B. M., 681
 Kramer, J. C., 532
 Kramer, M., 533
 Kretschmer, E., 116
 Krupp, I. M., 491
 Ktsanes, T., 456
 Kubie, L. S., 330
 Kuder, G. F., 153
 Kuramochi, H., 491
 Kurtz, A. K., 130
 Kvaraceus, W. C., 572, 573
 Kveim, K., 379

L

Lacey, J. I., 132
 Lachman, R., 204
 Lachman, S. J., 441
 Lacke, B. Z., 497
 Laird, D. A., 299
 Lambert, R. D., 681
 Lambert, W. E., 553
 Landauer, T. K., 659
 Landis, C., 495
 Lane, D., 74
 Lanier, L. H., 326
 Lashley, K. S., 58, 193, 201, 375-376, 669
 Lasswell, H. D., 585
 Lauterbach, C. G., 492
 Lawler, E. E., III, 411
 Lawshe, C. H., 568
 Lawson, E. D., 555
 Lawson, R., 651
 Lazarus, A. A., 515
 Lazarus, R. S., 224, 381
 Leach, B. E., 491
 Leahy, Alice Mary, 166
 Leavitt, H. J., 212, 213, 370, 554
 Lee, D., 321
 Lefford, A., 364
 Lefkowitz, J., 14
 Lehman, H. C., 104
 Lehtinen, Laura, 184
 Lele, T. T., 212
 Leonard, D. B., 269
 Lerner, I. M., 76
 LeShan, L., 439
 Leslie, J., 531
 Leuba, C. J., 242, 521, 545
 Leukel, F., 529
 Lev, J., 449
 Leventhal, H., 605, 606
 Levin, M. L., 532
 Levine, J. M., 251

- Levine, S., 98, 225, 659
 Levinger, G., 457
 Levinson, B., 242
 Levitt, E. E., 362
 Levy, E. Z., 330
 Lewin, K., 217, 564, 568
 Lewin, K. K., 438
 Lewinson, Thea S., 118
 Lhamon, W. T., 324
 Licht, L., 368
 Lifton, R. J., 613
 Lindley, C. J., 532
 Lindman, H., 360
 Lindner, R., 404
 Lindner, W., 321
 Lindsley, D. B., 339, 431
 Lindsley, O. R., 494
 Lindzey, G., 131, 145
 Linton, Harriet B., 118
 Lippitt, R., 564, 572
 Lipsitt, L. P., 89, 224
 Lipton, Rose C., 94
 Livingston, M., 492
 Llewellyn, T. E., 405
 Locke, E. A., 411, 412
 Locke, H. J., 453, 454, 455, 458
 Lockman, R. F., 11
 Loeb, Janice, 575
 Loevinger, Jane, 660-665
 Loevinger, P., 513, 514
 Long, L., 348
 Longmire, R. L., 656
 Lopez, T., 184
 Lorenz, K. Z., 192, 193, 195
 Lorr, M., 532
 Louttit, C. M., 325
 Lövaas, O. I., 405, 516
 Lovewell, E. M., 284
 Lowe, G. M., 169
 Lowell, E. L., 132, 398
 Lowrey, L. G., 450
 Lu, Y., 457
 Lubin, A., 117
 Luchins, A. S., 362, 524
 Luckhardt, A. B., 379
 Lumsdaine, A. A., 599, 608, 610
 Lundin, R. W., 493
 Luria, Zella, 482
 Luttgen, M., 200
 Lykken, D. T., 424
 Lyon, D. O., 226
- M**
- McArthur, Janet W., 63
 McCann, S. M., 385
 McCarthy, Dorothea, 93
 McCleary, G. E., 397
 McCleary, R. A., 56, 57, 380, 434
 McClelland, D. C., 132, 212, 309, 311, 398
 McClelland, W. J., 98
 Maccoby, N., 606
 McConnell, J. V., 186
 McCord, C. P., 289
 McCord, Joan, 575
 McCord, W., 575
 McCormick, E. J., 32
 McCurdy, H. G., 311, 553
 McDevitt, R. J., 151
 McDonald, W. T., 249
 McDowell, A. A., 242
 McGaugh, J., 200, 666-671
 McGeoch, J. A., 249, 250
 McGinnies, E., 312
 McGrath, J. J., 327, 328
 McGregor, D., 409
 McGuire, W. J., 608, 609, 611, 612
 McKay, H. D., 574, 576
 MacKinnon, D. W., 151
 Mackworth, N. M., 327
 McNair, D. M., 532
 McNemar, Q., 163
 Magoun, H. W., 654
 Mahan, C., 201
 Maire, P. F., 434
 Maier, N. R. F., 336
 Malinovsky, M. R., 410
 Malinowski, B., 658
 Maller, J. B., 546
 Mallory, Edith B., 119
 Malmö, R. B., 377
 Maltzman, I., 366, 368
 Mandler, G., 228, 451
 Mann, L., 521
 Mannheim, H. L., 557
 Manning, W. H., 243
 Margules, D. L., 381
 Mark, J. C., 492
 Marmur, J., 74
 Marple, C. H., 597
 Martens, S., 491
 Martin, B., 310
 Martin, C. D., 390
 Martin, J. R., 212
 Martinson, F. M., 454
 Maruzzi, G., 56
 Maslow, A. H., 125-126, 306, 338, 457, 481, 665
 Mason, C. D., 469
 Mason, D. J., 116
 Mason, H. L., 534
 Mason, J. W., 437, 656
 Masserman, J. H., 417, 471, 481
 Max, L. W., 340
 May, P. A., 361
 May, R., 512
 Mayfield, E. C., 128
 Mayr, E., 659
 Mayzner, M. S., 227
 Mead, L. C., 387
 Mead, Margaret, 402
 Meadow, A., 368
 Meals, D. W., 323
 Mech, E. V., 299
 Mednick, S. A., 184
 Medow, H., 555
 Meehl, P. E., 465
 Mees, C. E. K., 4
 Mees, H., 515
 Megargee, E. I., 578
 Meier, N. C., 173, 588
 Melzack, R., 97, 285, 286
 Meredith, C., 457
 Merrifield, P. R., 362, 420
 Merrill, Maud A., 154, 156
 Mettler, F. A., 201
 Meumann, E., 226
 Meuwese, W. A. T., 568
 Meyer, A., 535
 Meyer, D. L., 601
 Meyer, D. R., 397
 Meyer, P. M., 434
 Meyer, R. J., 438
 Meyer, W. J., 169
 Mickelson, O., 379, 383
 Milgram, S., 561
 Miller, Clyde R., 595
 Miller, G. A., 197
 Miller, J. G., 241
 Miller, L. K., 546
 Miller, N. E., 127, 381, 385, 398, 400, 401, 435, 438, 444, 652-660
 Miller, S. C., 537
 Miller, Virginia B., 119
 Millet, F. E., 437
 Mills, J., 601
 Mills, R. B., 151
 Milner, P., 435
 Milton, G. A., 363
 Milton, J. L., 327, 675
 Mintz, A., 32, 464
 Mintz, N. L., 306
 Mittelmann, B., 481
 Mohsin, S. M., 365
 Moles, O., 572
 Monachesi, E. D., 578
 Monahan, T. P., 454
 Moniz, E., 534
 Montagu, A., 76, 86
 Monzingo, F. L., 290
 Mook, D. C., 381
 Moore, R. Y., 57, 380
 Moreno, J. L., 518
 Morgan, C. D., 131
 Morgulis, S., 182
 Mosteller, F., 218, 589
 Mount, G. H., 173
 Mouton, Jane S., 551
 Mowrer, O. H., 23, 127, 475, 515, 517
 Mowry, H. W., 567
 Mueller, R. H., 370
 Mullan, H., 519
 Müller, J., 6, 58
 Munsinger, H., 90
 Murata, K., 222
 Murphree, H. S., 492
 Murphy, G., 251
 Murphy, Lois B., 25
 Murphy, P. D., 133
 Murray, E., 579
 Murray, H. A., 111, 131, 398, 661
 Mussen, P. H., 131, 132
 Muuss, R., 512
 Myers, A. K., 398
 Myers, G. C., 221
- N**
- Nagel, E., 113
 Nagge, J. W., 338
 Nakamura, C. Y., 364
 Nakao, H., 435
 Nakayama, T., 654
 Nance, R. D., 234
 Nathan, M., 534
 Nauta, W. J. H., 434
 Nebergall, R. E., 603, 604
 Nelsen, E. A., 408
 Nelson, P. D., 569
 Newcomb, T. M., 567
 Newhall, S. M., 270
 Newland, T. E., 13
 Newman, E. B., 250
 Newman, H. H., 165
 Newman, M. J., 493
 Newton, R. L., 130
 Nichols, R. C., 167
 Nickerson, D., 270
 Nicol, J. F., 332
 Niemeck, W., 437, 656
 Niles, Patricia, 605, 606
 Nissen, H. W., 96, 398
 Niwa, K., 576
 Noble, C. E., 101
 Nordie, P. G., 567
 Notterman, J. M., 183
 Nunnally, J. C., Jr., 502
 Nye, F. I., 572, 577
- O**
- Oberndorf, C. P., 512
 O'Brien, C. C., 534
 O'Connor, R. B., 300
 Odberg, H. S., 111, 314
 Oden, Melita H., 108
 Odulok, T., 289
 Olds, J., 381, 435, 532

Olds, M. E., 435
 Olin, C. H., 115
 Olsen, O., 205
 Olson, R., 487
 Olson, V. J., 572, 577
 Opler, M. K., 504
 Oppenheimer, R., 20
 Opsahl, R. L., 411
 Orbach, J., 487
 Orne, M. T., 30, 428
 Orr, D. W., 530
 Osborn, A. F., 369
 Osgood, C. E., 197, 482
 Ottinger, D. R., 87
 Owens, W. A., 107

P

Palamutlu, N., 368
 Palermu, D. S., 224
 Palestini, M., 56
 Papageorgis, D., 599, 611,
 612
 Palmcr, K., 589
 Paradise, N. E., 245
 Park, Lea C., 533
 Parkhurst, E., 87
 Parnes, S. J., 366, 368
 Parrish, J. M., 226
 Pasamanick, B., 601
 Pascal, G. R., 118
 Patel, M. M., 212
 Patrick, C., 355
 Pattie, F. A., 521
 Patton, H. D., 47, 291, 431
 Patton, R. E., 533
 Paul, G. L., 451, 526, 527
 Pavlov, I. P., 7, 181-185,
 296
 Payne, D. E., 34, 35
 Pearlman, L. I., 592
 Peck, R. F., 455, 661
 Peiper, A., 83
 Penfield, W., 201, 202
 Pennington, L. A., 546
 Perry, P., 587, 590
 Pescor, M. J., 496
 Peters, G. A., 420
 Peters, H. N., 514
 Petersen, H., 17
 Peterson, D. R., 579
 Petrinovich, L., 384, 667,
 669
 Pettigrew, T. F., 309
 Peyman, D. A. R., 519
 Pfaffmann, C., 291, 381,
 656
 Pfeiffer, C. C., 492
 Pfungst, O., 648
 Phillips, L. D., 360
 Pinget, J., 344, 346, 661,
 662, 665
 Pickett, R. M., 328
 Picree, Jean, 321
 Pine, G. J., 573
 Pinkerton, J., 441
 Pintner, R., 449
 Planck, E. H., 534
 Plato, 4
 Plant, T. F. A., 404
 Plotkinoff, N., 200
 Poffenberger, A. T., 205
 Polish, E., 437, 656
 Pomeroy, W. B., 390
 Pond, D. A., 456
 Porter, L. W., 553
 Porter, R. W., 192, 437,
 656
 Posner, M., 352
 Postman, L., 221, 308
 Powell, E. H., 470
 Prescott, D. A., 396, 449
 Pressey, S. L., 156
 Prevratil, W., 14
 Price, J. R., 575
 Priest, R. F., 598
 Pritchard, R. M., 263
 Pritzker, H. A., 599
 Pronko, N. H., 313
 Provence, Sally, 94
 Pruitt, D. G., 679
 Pubols, H. H., Jr., 213
 Purvis, M. H., 470
 Pushkar, Dolores, 329

Q

Quastler, H., 673

R

Rabinowitz, H. S., 365
 Rahe, R. H., 438, 439
 Rapaport, C., 240
 Raskin, D., 368
 Rasmussen, J. E., 123
 Rathiff, P., 263
 Rau, Lucy C., 408
 Rauth, J. E., 290
 Ravitz, L. J., Jr., 529
 Ray, W. S., 116
 Razran, G. H. S., 185, 296
 Reahl, J. E., 525
 Reckless, W. C., 579
 Redlich, F. C., 529
 Reed, C. F., 579
 Reed, H. B., 208, 211
 Reevy, W. R., 450
 Reiss, W. J., 502
 Reyna, L. J., 534
 Reynolds, G. S., 365
 Rheingold, Harriet, 400
 Rhine, J. B., 332
 Rice, S. A., 588
 Richman, H., 233
 Richter, C. P., 440
 Ricks, D. E., 452
 Riesen, A. H., 96
 Riggs, L. A., 263
 Rigney, F. J., 470, 471
 Riley, D. A., 232
 Riopelle, A. J., 283
 Risley, T., 515
 Rissland, L. Q., 222
 Robbin, J. S., 242
 Roberts, W. W., 435
 Robinson, Mary F., 535
 Robinson, R., 575
 Rodgin, D. W., 240
 Rodrigues, J., 308
 Roe, Anne, 132
 Roethlisberger, F. J., 30
 Roff, M., 580
 Roffwarg, H. P., 331
 Rogers, C. R., 19, 125, 508,
 510
 Rogers, M. C., 169
 Romanes, G., 395
 Rosen, N. A., 587
 Rosenberg, M., 592
 Rosenberg, M. J., 522
 Rosenblueth, A., 341
 Rosenman, R. F., 439
 Rosenthal, D., 491
 Rosenthal, R., 645-652
 Rosenzweig, S., 468, 524
 Roslow, S., 452
 Ross, Dorothea, 405, 406
 Ross, Helen, 400
 Ross, Sheila A., 405, 406
 Ross, S., 11
 Ross, V. R., 173
 Rossi, G. M., 56
 Roth, I., 532
 Roth, J., 455
 Rothstein, C., 532
 Rotter, J. B., 568
 Rounds, C. H., 205
 Ruch, F. L., 152, 189, 233,
 243, 246, 586
 Ruch, T. C., 47, 264, 291,
 387, 431
 Ruch, W. W., 32, 152,
 567
 Ruff, G. E., 330
 Rugg, D., 586
 Runyon, D. L., 310, 311
 Russell, B., 6
 Russell, Jane A., 379
 Russell, J. T., 144
 Rust, M. M., 348
 Rutherford, Avonell, 532
 Rutherford, E., 281
 Ryle, A., 456

S

Sabagh, G., 458
 Saltzman, I. J., 425
 Samet, S., 381
 Sampliner, R. I., 385
 Sampson, E. E., 198
 Sanders, A., 674
 Saunders, A. F., 250
 Sanders, R., 525
 Sanford, N., 494
 Sansom, Wilma, 329
 Sarason, Barbara, 222
 Sarason, I. G., 222
 Sarason, S. B., 451
 Sarbin, T. R., 578, 579
 Sargent, S. S., 595
 Satinoff, Evelyn, 389
 Savage, C., 533
 Savage, Ethel, 533
 Sawrey, W. L., 436
 Schlaachter, S., 427, 428
 Schaie, K. W., 106
 Schein, E. H., 612
 Schenetzki, D., 368
 Scherer, I. W., 535
 Scherrer, H., 296
 Schjelderup, H., 525
 Schlosberg, H., 212, 213,
 248, 418, 419, 656
 Schoenfeld, W. N., 183
 Schott, E. L., 169
 Schreiber, F., 386
 Schreiner, L., 434
 Schroder, H. M., 661
 Schubert, H. J. P., 205
 Schuessler, K. F., 578
 Schumsky, D. A., 231
 Schwarting, B. H., 267
 Schwartz, R. J., 237
 Schwartzbaum, J. S., 434
 Scotch, N. A., 656
 Scott, R. H., 580
 Scott, T. H., 97
 Scott, W., 189
 Searle, L. V., 387
 Sears, A. B., 240
 Sears, D. O., 610
 Sears, Pauline S., 405, 466,
 521
 Sears, R. R., 127, 222, 464
 Seashore, C. E., 173
 Seashore, S. E., 30
 Seay, B., 97
 Secord, P. F., 115
 Seeman, J., 509
 Segal, J., 613
 Segal, M. M., 531
 Segalman, R., 103
 Seguin, C. A., 436
 Seltzer, A. L., 426
 Selye, H., 440, 463
 Semmes, Josephine, 96

- Senden, M. v., 96
 Senders, J. W., 671-677
 Senders, V. L., 221
 Shaffer, L. F., 470
 Shaklee, A. B., 232
 Shammon, C. E., 369
 Shapiro, K. L., 531
 Shaw, C. R., 574, 576
 Shaw, M. E., 554, 555, 556, 566
 Shaw, Orda, M., 502
 Sheffield, F., 599, 608
 Sheffield, F. D., 382
 Sheldon, W. H., 116-117
 Sherif, Carolyn W., 548, 603, 604
 Sherif, M., 312, 548, 603, 604
 Sherman, H., 312
 Sherman, J. A., 515
 Sherrington, C. S., 39, 53
 Shields, J., 165
 Shipley, W. C., 185
 Shirley, M. M., 91
 Shlien, J. M., 426
 Shneidman, E. S., 464, 466
 Shoben, E. J., Jr., 470, 476, 523
 Short, J. F., 572, 577
 Shurrager, H. Z., 226
 Shuttlesworth, F. K., 588
 Siegel, S., 360
 Siegman, A. W., 575
 Simmons, J. E., 87
 Simon, C. W., 242
 Simon, R., 525
 Simon, S., 368
 Simon, T., 153
 Simpson, W. J., 87
 Sinclair, L., 384, 402
 Singer, J. E., 427
 Singer, J. L., 535
 Singer, R. D., 421, 422, 605
 Singh, B. N., 453
 Sinnott, J. J., 290
 Skard, A. G., 129
 Skinner, B. F., 19, 215, 216, 494
 Slamecka, N. J., 250
 Slater, E., 490
 Slavson, S. R., 519
 Sloan, W., 158
 Slucki, H., 192
 Sluckin, W., 410
 Smith, A., 535
 Smith, B. F., 534
 Smith, J. A., 532
 Smith, K. U., 92
 Smith, Madorah E., 214
 Smith, M., 380, 381
 Smith, M. F., 83
 Smith, N. J., 92
 Smith, O. A., 534
 Smith, P. M., 575
 Smoke, K. L., 351
 Smolarz, W., 86
 Snoddy, G. S., 212
 Sobel, Edna H., 63
 Solomon, H. C., 494
 Sontag, L. W., 86
 Spalding, D. A., 192, 446
 Spearman, C., 162
 Spears, W. C., 90
 Spelt, D. K., 86
 Spence, K., 184, 215
 Spencer, M. S., 290
 Sperber, S. S., 3
 Sperling, H., 276
 Sperry, R. W., 62, 201, 653
 Spiegel, J. P., 529
 Spranger, E., 145-146
 Springer, D., 323
 Springer, N. N., 452, 532
 Staats, A. W., 199
 Staats, Carolyn, 199
 Stagner, R., 14, 394, 433, 562
 Stalnaker, J. M., 19
 Stamler, R., 656
 Stampfl, T., 242, 514
 Stanley, W. L., 290
 Starch, D., 232
 Stechler, G., 87
 Steele, J. P., 242
 Stein, L., 435
 Stellars, E., 200, 380, 381
 Stennett, R. G., 377
 Stern, C., 74
 Stern, W., 154
 Stembach, R. A., 284
 Stevens, S. S., 116, 616
 Stice, C. F., 566
 Stocov, F. C. L., 323
 Stockford, L. O., 568
 Stone, C. P., 529
 Stone, G. B., 525
 Stratton, G. M., 317
 Straus, M. A., 167
 Strecker, E. A., 478, 480, 488, 489
 Stricker, C., 590
 Strickler, C. B., 240
 Stride, E., 285
 Strong, E. K., Jr., 152
 Sugarman, A. A., 492
 Sullivan, D., 661
 Sullivan, H. S., 662
 Sullivan, M. W., 401
 Sulzman, J. H., 267
 Summers, S. S., 366
 Suppes, P., 349, 350, 360
 Sutherland, E. H., 577, 579-580
 Suttentfield, Virginia, 478
 Sweeney, E. J., 169
 Szasz, T. S., 436
- T**
- Taft, L. T., 87
 Takahashi, R., 491
 Talbot, E., 537
 Talbot, N. B., 63
 Talland, G. A., 567
 Tallent, N., 502
 Tarver, F. D., 455
 Taylor, D. W., 365, 551, 552
 Taylor, H. C., 144
 Taylor, H. L., 379, 383
 Taylor, S. J., 504
 Taylor, W. R., 172
 Teel, K. S., 274
 Teichner, W. H., 324, 326
 Teitelbaum, P., 380, 381
 Tenoppy, Mary L., 567
 Terrace, H. S., 205
 Terman, L. M., 26, 154, 156, 158, 169, 455, 456
 Thach, J. S., 437, 656
 Thaler, V. H., 330
 Theios, J., 206
 Thelen, H. A., 562, 563
 Thigpen, C. H., 483
 Thomas, J., 514
 Thomes, Mary M., 458
 Thompson, Clare W., 107
 Thompson, W. R., 97
 Thompson, R., 58
 Thorndike, E. L., 7, 25, 163, 216, 395
 Thorne, F. C., 464, 476
 Thornton, G. B., 205
 Thurber, Emily, 575
 Thurstone, L. L., 162-163
 Thurstone, Thelma G., 162-163
 Tiffin, J., 14, 32
 Tillmann, W. A., M.D., 33
 Titchener, E. B., 7
 Tolman, E. C., 217
 Tolsma, F. J., 467
 Tonkin, Sandra, 151
 Torrance, E. P., 367, 368
 Totten, E., 340
 Traub, A. C., 487
 Travis, R. C., 327
 Tremaine, M. J., 290
 Tresselt, M. E., 227
 Trevarthen, C. B., 62
 Triandis, H. C., 553
 Tripp, C. A., 118
 True, R. M., 522
 Tsang, Y. C., 379
 Tschukitschew, 379
 Tucker, B. E., 386
 Tucker, W. B., 116
 Tuddenham, R. D., 561, 562
 Turner, A. J., 404
- Turner, Judith A., 602
 Turrell, E. S., 436
 Tyl, Mary, 452
 Tyler, R. W., 212
- U**
- Uehling, H., 338
 Uhlenhuth, E. H., 533
 Underwood, B. J., 26, 184, 214, 232, 250
 Ursin, H., 434
- V**
- Valenstein, E., 435
 Valentine, C. W., 445
 Van Ormer, E. B., 249
 Veldman, D. J., 492
 Vernon, J. A., 241, 607
 Vernon, M. D., 308
 Vernon, P. E., 145
 Veroff, J., 506
 Vick, P., 23
 Vinacke, W. E., 355
 Viteles, M. S., 277
 Vogel, W., 492
- W**
- Waggoner, R. W., 531
 Wagoner, K. S., 387
 Wain, L., 489
 Walk, R. D., 98, 99, 302
 Walker, A. E., 291
 Wallach, M. A., 552
 Wallas, G., 355
 Wallin, P., 455
 Walter, A. A., 344
 Walters, R. H., 405, 407, 576
 Ward, L. B., 244
 Warden, C. J., 235
 Warren, J. M., 202, 204
 Washburn, A. L., 378
 Washburne, A. C., 534
 Wasson, Ruth, 231
 Watson, James, 74
 Watson, John B., 7, 216, 442-445
 Watts, H. G., 502
 Watts, J. W., 534
 Watts, W. A., 608, 609
 Wawryk, R., 86
 Webb, W. B., 569
 Weber, D. E., 437
 Wechsler, D., 155
 Wechsler, H., 533
 Weckler, J., 403
 Weil, R. J., 504

- Weinberg, G. H., 118
 Weingarten, E., 525
 Weininger, O., 98
 Weisenberg, M., 286
 Weiskrantz, L., 191
 Weiss, R. F., 601
 Weiss, W., 597, 608
 Weisskopf-Joelson, Edith, 513
 Weist, W. M., 553
 Weisz, J. D., 436
 Welch, L., 290
 Wernicke, C., 60
 Wernimont, P. F., 409
 Wertheimer, M., 7, 217
 Wessman, A. E., 452
 West, D. J., 332
 West, L. J., 612
 Wever, E. G., 281
 Whalen, 409
 Wheatley, M. D., 433
 Wheeler, L., 427
 Whipple, J. E., 228
 White, R. K., 564
 White, R. W., 398, 474, 480
 Whitehead, A. N., 4
 Whiting, J. W. M., 659
 Whittenmore, I. C., 546
- Whorf, B., 344, 345
 Wiener, N., 341
 Wiesel, T. N., 266, 275, 652
 Wilcott, R. C., 241
 Wilder, R. M., 534
 Wilensky, H., 535
 Wilkins, M., 74
 Willey, R. deV., 211
 Williams, D. C. S., 546
 Williams, R. D., 534
 Williams, R. J., 495
 Williamson, R. C., 455
 Willits, Fern K., 454
 Wilson, D. P., 455
 Wilson, R. C., 325, 327
 Wilson, W., 117
 Winch, R. F., 456
 Winder, C. L., 408
 Windle, W. F., 83
 Winkelman, N. W., Jr., 532
 Winne, J. F., 535
 Winterbottom, Marian R., 399
 Wishner, J., 30
 Witheridge, W. N., 289
 Withey, S., 572
 Witkin, H. A., 315
- Woddiss, G. M., 537
 Wolf, M., 515
 Wolf, S., 437
 Wolfe, J. B., 400
 Wolff, H. G., 436, 437
 Wolfson, Rose, 118
 Wolpe, J., 513
 Woodrow, P., 385
 Woodrow, H., 243
 Woodworth, R. S., 248
 Woodyard, Ella, 169
 Woolf, Virginia, 321
 Worchel, P., 22
 Worrell, C. H., 169
 Wortis, J., 529
 Wundt, W., 6, 7, 20
 Wurtman, R. J., 5
 Wyatt, S., 323
- Y
- Yacorzynski, G. K., 386
 Yamamoto, K., 368
 Yaryan, Ruby B., 361
 Yerkes, R. M., 182
 Young, P. T., 384
 Young, T., 274
- Yousem, H., 381
 Youtz, A. M. C., 248
 Yuker, H. E., 253
- Z
- Zajonc, R. B., 558
 Zanchetti, A., 56
 Zander, A., 555
 Zborowski, M., 286
 Zeff, L. H., 557
 Zeigarnik, B., 251
 Zeigler, H. P., 242
 Ziller, R. C., 566
 Zimbardo, P. G., 97, 240, 286, 341, 389, 600
 Zimmerman, Claire, 681
 Zimmerman, R. R., 393, 656
 Zimmerman, W. S., 147
 Zinszer, H. A., 208
 Zorbaugh, F. M., 574, 576
 Zubeck, J. P., 329
 Zubin, J., 118
 Zuckerman, M., 362
 Zuckerman, S., 63
 Zusman, J., 401
 Zwerg, C., 92

Subject Index

A

- Ability, and age, 245-248; growth and decline of human, 104-108; artistic, 173; athletic, 171-172; learning and, 243-245; musical, 172-173; primary mental, 161-170; psychomotor, 170-171
- Ablation, 291
- Absolutely refractory period, 47
- Absolute savings score, 210-211
- Abstraction, 347-348
- Accident(s), causes of, 32-33; personality characteristics and, 33; prevention, 33-34; proneness, 32-33; rate and highway design, 33
- Accommodation (eye), 262
- Accuracy of response as a criterion of learning, 204-205
- Achievement, measures of, 138-139; need for, 132, 398-399
- Acoustic reflex, 282-283
- Acromegaly, 79-80
- ACTH (corticotropin), 64, 440, 656
- Action (behavior) therapy, 513-515, 516, 525-527
- Action potential, 48; method of studying the brain, 54
- Adaptation, sensory, 258, 260-261, 287
- Addiction. See Drugs.
- Adjustive behavior, 39-41; in everyday life, 505
- Adjustment, organs of, 40; principles of good, 505
- Adolescence, emotional development during, 450; maturation during, 81-82
- Adrenal androgens, 80-81
- Adrenal cortex, 63, 64, 80-81, 441
- Adrenal glands, 63, 64, 423, 430; and physical development, 80-81
- Adrenal medulla, 63, 64, 423
- Adrenaline, 63, 64, 423-424
- Adulthood, and emotional maturity, 450-452
- Advertising, institutional, 592-594; objectives of, 591; research for, 591-592
- Affective reaction, 486, 488-489
- Affective scale, 415
- Afferent neuron, 42, 43, 44, 45, 46, 57
- Afterdischarge, 51
- After sensations, negative and positive, 272-273
- Age, discrepancy and marital success, 454; emotional problems of old, 452-453; and learning ability, 245-248; mental, 153-154, 166
- Aggression, 404-407, 444, 464-468, 520
- Aggressive reactions to frustration, 464-468
- Agnosias, 60
- Air hunger, 386
- Alarm reaction, 440
- Alcoholics Anonymous, 495
- Alcoholism, 494-496
- Alexia, 60
- Alpha rhythm, 242
- Ambivalence, 512
- American Psychological Association, 10
- Amnesia, 481
- Amniotic fluid, 84
- Ampullae, 287
- Amygdala, 432, 434
- Anal period of libidinal urges, 120-121
- Analytic psychology of Jung, 123-124
- Anatomical method of studying the brain, 53
- Androgens, adrenal, 80; testicular, 81, 389
- Anchoic chamber, 258
- Animals, in psychological research, 8-9, 53-54
- Anomie, 503
- Anoxia, 386
- Anthropology, 9
- Anvil, 279, 280
- Anxiety, influence on effectiveness of propaganda, 604-606; learning influenced by, 224-225; in neuroses, 476-478; reduction of, in therapy, 514, 526-527
- Anxiety reactions, 476-478
- Aphasias, 60
- Appetites, 383-384
- Approach as an emotional response, 423
- Aptitude, measures of, 138-139
- Archetypes, 124
- Army General Classification Test, 157
- Arousal, 56; in motivation, 376-377
- Artistic ability, 173

- Ascending reticular system, 56, 57
- Assimilation, in communication, 603-604
- Association areas, 59-60
- Astereognosis, 60
- Asthenic reaction, 484
- Astigmatism, 268, 269
- Athletic ability, 171-172
- Attention, 295-300; aspects of, 295-296; direction of, 297-298; distraction of, 298-300; role of central nervous system in, 296-297, 654; selective, 676-677; shifting of, 298
- Attitude, change through international contact, 679-687; change through propaganda, 595-613; learning of, 198-199
- Attitudinal reflex, 296
- Auditory area of the brain, 281-282
- Auditory nerve, 280
- Autistic thinking, 335-336
- Autonomic nervous system, 428-431; division of labor in, 430
- Aversive conditioning, 187, 188-189
- Avoidance conditioning, 188, 189
- Axon, 42, 45-46

B

- Band wagon as a persuasive device, 596-597
- Bargain as a method of leadership, 564
- Beatnik reaction, 470-471
- Behavior, as adjustment, 39-41; defined, 8; development of, 69-74; effects of motivation on, 376-377; goal directed, 375-378; modification of, 19; physiological and cultural determinants of, 654-662
- Behavior sampling, 150-151
- Behavioral content (in structure of intellect), 163, 164
- Behavioral science, 9
- Behaviorism, in learning theory, 216; in study of emotion, 442-444
- Bell-shaped curve. See Normal distribution
- Between variance, 638-639
- Bias, in opinion polls, 586
- Binet tests, 153-155

- Binocular perception of depth, 315
Biographical method, 25-26
Biological drives, 378-395, 655; air hunger, 386; bowel and bladder tensions, 392; contact comfort, 392-393; fatigue, 386-388; as homeostatic mechanisms, 393-395; hunger, 378-384; measurement of, 378; pain, 391-392; sexual, 389-391; sleep, 386-388; thirst, 384-386; warmth and cold, 388-389
Biology, 9
Bipolar cells, 266
Birth injury, 87
Bit, 370
Bladder tensions, 392
Blind spot, 260
Blood types, 76
Blur point, 269
Body chemistry, as a factor in psychoses, 491-492
Body-type theories of personality, 114-117
Bowel tensions, 392
Brain, association areas in, 59-60; centers of emotion in, 431-433; growth in early years, 88; main parts of, 54-57; mechanism as a basis for behavior, 654-659; methods of studying, 53-54; potentials, 431; in thinking, 338-339. See also Nervous system
Brain stem, 43, 56
Brain waves, 339, 431
Brainstorming, 368-369, 551
Brainwashing, 612-613
Brightness, 270
Broca's area, 6, 60
Bundle of Oort, 296
- C**
Card stacking as a persuasive device, 596
Castration, 81
Catatonia, 488
Catharsis, 508
Cathode ray oscilloscope, 48
Centiles, 143, 623-624
Central mechanisms in vision, 264-266
Central nervous system, 42. See also nervous system
Central value, measures of, 139-141, 618-620
Centrifugal impulses, 43, 296-297, 654
Cerebrum, 54-56; localization of function in, 57-62, 288, 290, 291-292
Ceruloplasmin, 491
Channel, 369
Chemical method of studying the brain, 54
Chemical senses, 289-292
Chemotherapy, 530-533
Chicago Area Project, 581-582
Children, concept formation by, 345-351; desire for, and marital success, 455-456; effects of environment on, 93-95, 99, 106; emotional development of, 448-450; maturation of, 77-79. See also Parent-child relations
Chlorpromazine, 531-532
Choroid coat, 259
Chromatin body, 77
Chromosomes, 74, 75
Chronoscope, 324
Clairvoyance, 332
Classes (in structure of intellect), 163, 164
Classical conditioning, 181-186
Cleft palate, and emotional disturbances during pregnancy, 86; and radiation, 87
Client-centered therapy, 508-510
Clinical method of study, 25
Closure, in perception, 304
Cochlear canals, 279, 280
Coded signal, 369
Cognition (in structure of intellect), 163, 164
Cognitive dissonance, 285-286, 360-361, 599-600
Cognitive theories of learning, 216-217
Cold, sensitivity to, 286-287; as a drive, 388-389
Collaterals, 46
Color, blindness, 275-277, color Plate II; laws of mixture, 271-272; naming, 273-274; qualities of, 270-271; Color Plate I; vision, 270-275
Color solid, 271, Color Plate I
Color wheel, 271, Color Plate I
Commissures, 61
Communication, and marital success, 457-458; feedback in, 370; influence on group action and morale, 553-555; nets, 554-555; parts of a system of, 369
Community, planning in preventing delinquency, 581-582; role in caring for mentally ill, 506, 538-539
Compensation, as a reaction to frustration, 473
Competition, effects of cooperation and, 543-550; instinct of, 543-545; planning for effective, 550
Complementary, colors, 272; tastes, 290
Compromise reactions, 472-475
Compulsions, 480
Concepts, formation of, 345-351; informational approach, 351-352; in thinking, 345
Conditioned inhibition, 185
Conditioned response (CR), 182
Conditioned stimulus (CS), 182
Conditioning, 181-191; classical, 181-186; higher order, 184-185; instrumental, 186-191; in therapy, 513-515
Cones, 260, 261, 263-264, 274-275
Confidence intervals, 634-635
Conflict, types of, 462
Conflict frustration, 462
Conformity, to group opinion, 557, 560-562
Conjugate movements (eye), 262
Connectors, 41, 44, 45
Conscious experience, 7; attention as, 295; emotion as, 415-416
Consolidation of memory engram, 202-203, 667
Consummatory response, 375
Contact comfort, 392-393
Context, in perception, 304-306
Contiguity theory of learning, 216
Contrast effects, in communication, 603-604; simultaneous hue and simultaneous brightness, 272; in taste, 290
Control, experimental, 27-28; as objective of psychology, 19; statistical, 31
Control group, 27, 28
Convergence, of eyes, 262, 315; of nerve impulses, 49, 51
Convergent production (in structure of intellect), 163, 164
Conversion reaction, 483-484
Cooperation, effects of competition and, 543-550; international, 679-687; and marital success, 457
Cornea, 259, 260
Corpus callosum, 57, 61-62
Correlation, 143-145; measures of, 624-626, 627
Cortex, cerebral, 55, 57-61, 288, 290, 291-292, 431-432, 434
Cortical functioning in emotion, 431-432
Corticotropin (ACTH), 64, 440, 456
Cortin, 440
Courtship, 455
Covariance, analysis of, 640-641
Crano-sacral division. See Parasympathetic division of autonomic nervous system
Creativity, 367-369; characteristics of, 367-368; developing, 368-369
Cretinism, 80
Crime. See Delinquency
Crises, in life cycle, 122-123; life, and health, 438-439
Criterion, 204
Critical period, 661; for imprinting, 193-196

- Critical ratio, 632, 634
 Critical region, 633, 634
 Cross-sectional approach, 105-106
 Cue function, 377
 Culture, as a determinant of behavior, 658-662; intelligence related to, 167-168; perception influenced by, 306-307, 311, 312
 Culture-fair tests, 168
 Curiosity, 395-398
 Curves of learning, 206-209
 Cutaneous senses, 283-287
 Cybernetics, 341
 Cycles per second (cps), 277
 Cyclofusional movement (eye), 262
- D**
- Dark adaptation, 260-261
 Davis-Ellis Games, 168
 Daybook method, 24-25
 Daydreams, 469-470
 DDD (debility, dependency, and dread), 612-613
 Deafness, intensity, 282-283; tone, 283
 Decibel (db), 279
 Decision making, 359-361
 Deductive, explanation, 113; thinking, 336
 Defense mechanisms, 463-475
 Degrees of freedom (df), 628
 Déjà vu, 228
 Delayed reaction tests, 337-338
 Delinquency, 571; and environment, 572-577; improvements in treatment of, 580-581; and personality, 577-580; prevention of, 581-582
 Delirium tremens, 488
 Delusions, 486-488
 Demonology, 3
 Dendrites, 42, 45, 46
 Denial, 593
 Dependency, 407-408
 Dependent variable, 27, 28
 Depressive episodes, 488-489
 Depressive reaction, 484-485
 Depressive, cultural, 166; emotional-social, 94, 97-98; sensory, 95-97, 328-330
 Depth techniques, 129-134
 Description, as an objective of psychology, 16
 Descriptive statistics, 619-627
 Destruction as an emotional response, 422
 Development, determinants of, 69-74; during infancy, 88-93; early social, 92; emotional, 442-453; and environment, 93-103; measurement of, 663-665; prenatal, 83-88
 Developmental tasks, 101-103
 Dichromatic color vision, 276, Color Plate II
 Differentiation of emotions in infancy, 446-447
 Dimension, defined, 17
 Dimensions of personality, 112
 Diplopia, 268, 269
 Directive counseling, 508
 Discrimination Learning, 191-192, 193; differentiated from imprinting, 194
 Disinhibition, 185
 Displaced aggression, 464-466
 Dissociation, 351
 Dissociative reactions, 480-483
 Distraction, 298-300
 Distribution, 619
 Divergence, 49, 51
 Divergent production (in structure of intellect), 163, 164
 Dizygotic twins, 77
 DNA (deoxyribonucleic acid), 74-75
 Doll play, 466, 467, 520
 Dominance, cerebral, 62; genetic, 76
 Dorsal column (of the spinal cord), 46, 49
 Double alternation tests, 338
 Double-blind test, 16; 531
 Dreams, analysis of, 511; need for, 330-331; as a reaction to frustration, 470
 Dream work, 511
 Drives. See *Biological drives and Motivation*
 Drugs, addiction to, 494, 496-497; effects on memory storage, 671-673; influence on time perception, 324; use of, in therapy, 530-533
 Dvornic Pseudo-Isochromatic Plates, Color Plate II
 Dwarfism, 80-81
- E**
- Ear, structure of, 279-280
 Eardrum, 280
 Eclecticism, 8, in therapy, 535-538
 Ectomorphy, 116
 Education, and marital success, 453
 Effectors, 41, 44-45, 46
 Efficient neurons, 42, 43, 44, 45, 46
 Effort as a criterion of learning, 205
 Ego, 120; development, 661-665; stages of development of, 663-665
 Ego-involvement, and frustrations, 463; and persuasion, 603-604
 Eidetic imagery, 342-343
 Elaboration of latent consequences, 592-593
 Electroconvulsive shock (ECS), and memory, 666-667; in therapy, 527-529
 Electroencephalograph (EEG), 242, 431
 Electromyograph, 376
 Embryology, defined, 9
 Embryonic period, 84
 Emotion, aspects of, 415-417; as conscious experience, 415-416; development of, 442-453; as energizer, 416-417; expression of, 417-423; fetus affected by mother's, 86; and forgetting, 250-252; and health, 435-441; nervous system in, 428-435; overt behavior in, 422-423; physiological changes during, 423-428
 Empathy, 417, 567
 Employees, motivation and, 409-411; needs of, 409-410
 Encoding, 369
 End brushes, 45
 End plates, 45-46
 Endocrine glands, 62-64, 79-82; 440-441
 Endomorphy, 116
 Energetics, 375
 Energizer, emotion as, 416-417; in psychotherapy, 532-533
 Engram, 202, 666-667
 Environment, as a determinant of intelligence, 165-170; effects of enriched, 98-101; effects of impoverished, 93-98; as a factor in delinquency and crime, 572-573; as a factor in psychoses, 492-493; influence on development, 69-70, 93-103; and marital success, 455
 Environmental frustration, 461
 Epidemiology, 503-504
 Escape conditioning, 188-189, 435
 Estrogens, 63, 81-82, 390
 Estrus, 390
 Ethics and psychology, 30-31
 Eustachian tube, 280
 Evaluative thinking, 337; in structure of intellect, 163, 164
 Evoked potentials, 339
 Exchange programs, 677-685
 Excitatory postsynaptic potential (EPSP), 48-49, 653
 Existential, psychotherapy, 512-513; theory of personality, 127
 Expectancy effects, 647-652
 Experimental control, 27-28
 Experimental design, 26, 28
 Experimental extinction. See *Extinction*
 Experimental method of study, 26-31
 Experimenter effects, 646-652
 Explanation, types of, 112-113
 Expressive behavior as a clue to personality, 117-119
 Extinction, 183, 189, 205-206
 Extirpation method of studying the brain, 53-54

Extrapolation, 358-359
 Extrasensory perception, 331-332
 Extraversion, 124
 Extrinsic motivation, 223, 409-411
 Eye, anatomy of, 259-260; movements in focusing, 261-262

F

F distribution, 640
 F ratio, 639
 Facial expression of emotion, 417-418
 Factor, analysis, 161-163
 Factor-analytic approach to personality measurement, 146-149
 Factorial design, 641-642
 Family, breakdown and delinquency, 574-575; psychotic disorders related to, 490-491; size and intelligence, 169-170
 Fantasy, 469-470
 Far-sightedness. See *Hyperopia*
 Fatigue, 386-388
 Fear, in imprinting, 194; in infants, 446-447; influence on effectiveness of propaganda, 604-606
 Feedback, 41; in communication, 370; importance of sensory, 229-231, 340-342
 Fetal period, 84; behavior during, 84-86
 Field-study method, 24
 Field theory, 124-125
 Figural content (in structure of intellect), 163, 164
 Figure, 304
 Finger dexterity, as a psychomotor ability, 170; test, 18
 Fissure of Rolando, 54, 55, 58, 60
 Fissure of Sylvius, 54, 55, 58, 60
 Flogging the dead horse, 597
 Force as a method of leadership, 563-564
 Forced-choice rating scale, 150
 Foreign aid, implications for attitude change in, 683-685
 Fore-period, 326-327
 Forgetting, 209-214, 248-253; and emotional and motivational factors, 250-252; interference from later activity, 249-250; and meaningfulness, 250; partial learning, 248; and reviewing, 248; social factors and, 252-253. See also *Retention*
 Form boards, 155, 160
 Fovea, 260
 Free association, 510-511
 Free-floating anger, 464
 Frequency distribution, 630
 Frequency theories of hearing, 280-281
 Freudian theory. See *Psychoanalysis*
 Fröhlich's syndrome, 169
 Frontal lobe, 55, 60, 432, 534
 Frustration, defensive reactions to, 463-475; dynamics of, 463; kinds of, 461-462; learning influenced by, 224; in problem solving, 365
 Fugue, 481
 Functional connections, 78-79
 Functional explanation, 113
 Functional fixity in problem solving, 362-367
 Functional psychoses, 485-489; classification of, 486
 Functionalists, 7
 Funneling, 280

G

Galvanic skin response (GSR), 424-425
 Gambling, compulsive, 497-498
 Gametes, 74
 Ganglion cells (visual), 266
 General-adaptation-syndrome, 440-441
 Genes, 74; dominant and recessive, 76
 Genetic explanation, 113
 Genetics, defined, 9, 74
 Genital period of libidinal urges, 121
 Germ cells, 74
 Germinal period, 84
 Gestalt, psychology, 7, 124-125; theories of learning, 217
 Giantism, 79
 Gifted mentally, 156-159
 Glandular responses during emotion, 423-424
 Glittering generalities as a persuasive device, 596
 Glutathione, 491
 Goals. See *Behavior*
 Gonds, 63, 64; and physical development, 81-82
 Graphic representation of emotion, 420
 Graphology, 117-119
 Greece, contributions to scientific thought, 3-4
 Ground, 304
 Group, action vs. individual, 551-552; counseling, 580; effects of competition and cooperation on behavior of, 547; functioning, factors in small, 552-562; leadership, 562-563; therapy, 519-520
 Group-centered leadership, 563
 Growth, physical, 77-78
 Guidance, as an aid to learning, 236-239; counseling, 13; facilities, 505-506, 538; vocational, 19
 Guilford-Zimmerman Temperament Survey, 147-149
 Gustatory sense, 290-292

H

Habit strength (H_H), 215
 Hallucinations, 488, and sensory deprivation, 328-330
 Hallucinogens, 491-492, 533
 Halo effect, 128
 Hammer, 279, 280
 Handwriting analysis, 117-119
 Hardy-Rand-Rittler Test, Color Plate II
 Health, and emotions, 435-441; and intelligence, 169; and life crises, 438-439
 Healy Picture Completion Test, 160
 Hearing, 277-283; area of brain, 281-282; defective, 282-283; development in infant, 89; mechanism, 279-282; perception of sound, 320-321; theories of, 280-281
 Hemianopia, 265
 Hemispheres of the brain, 54-55; connection between, 61-62
 Heredity, defined, 69; as a determinant of intelligence, 165-167; as a factor in psychoses, 490-491; influence on development, 69-70; and maturation, 70; mechanisms of, 74-77
 Hering theory of color vision, 275
 Heroin, 496, 497
 Heterozygous, 76
 Hippocampus, 56, 201
 Homeostasis, 62, 654; as a biological drive, 393-395
 Homozygous, 76
 Homnetic factors, 146-147
 Hormone, defined, 62; secretions, 62, 79, 655
 Hospitals. See *Mental hospitals*
 Hostility, competition and, 547-549; controlled expression of, 467-468
 Hue, 270, Color Plate I
 Hull's formal theory of learning, 215
 Human engineering, 14, 15
 Human performance, 671-677; boundaries of, 672
 Humanization, 593
 Hunger drive, 378-384, 655
 Hyperalgesia, 285
 Hyperopia, 268, 269
 Hypnosis, learning under, 240; in psychotherapy, 521-523
 Hypochondria, 484
 Hypothalamus, 56, 57, 656; and biological drives, 380, 381, 385, 388-389; in emotion, 433-435
 Hypothesis, 26-27, 28

Hypothetical construct, 23
Hysteria. See Conversion reaction

I

Id, 120
Ideational learning, distributed practice and, 232-233
Identical twins, 77
Identification with the aggressor, 474-475
Idiographic approach to personality, 113-114
Idiot, 158, 159
Illegal behavior. See Delinquency
Illusion, 302
Imagery in thinking, 342-344
Imbecile, 158, 159
Imipramine, 532-533
Immunization, against propaganda, 609-612
Implications (in structure of intellect), 163, 164
Implicit speech, 340
Implosive therapy, 514
Imprinting, 192-196; differentiated from discrimination learning, 194
Impulsiveness, related to delinquency, 578-579
Inclusiveness, in perception, 304
Incidental learning, 208, 222
Independent variable, 27, 28
Individual psychology of Adler, 124
Individuation, 82-83
Inductive method, 4
Inductive thinking, 337
Infants, development of, 88-93; emotions in, 446-447; physical structure, 88; sensory development of, 88-90; social development of, 92-93
Inferiority feelings, frustration and, 462
Informational approach, 351-352
Information theory, 369-370
Inhibition, conditioned, 185; in nervous system, 48-49, 380, 381, 432, 434, 653; reciprocal, 514; reciprocal innervation, 52-53
Inhibitory postsynaptic potential (IPSP), 48-49, 653
Inkblot test. See Rorschach Test
Innate needs, 377, 378-395
Input, 341-342
Insanity, legal definition, 485
Insight, in problem solving, 353-355; therapy, 508-510, 513
Instinct, 71-74, 216, 442-443
Institutional advertising, 592-594
Institutional care, for delinquents, 580-581; for mentally ill, 536-537. See Mental hospitals

Instrumental conditioning, 186-191; applications of operant techniques, 190-191
Insulin, 62, 63
Integrity therapy, 515, 517
Intellectualization, as a reaction to frustration, 473-474
Intelligence, determinants of, 165-170; and leadership ability, 568; and occupation, 157; structure of, 163-165; testing of, 153-161
Intelligence quotient (IQ), classification of, 156; constancy of, 161; defined and computed, 154; meaning in terms of behavior, 155-161
Intensity deafness, 282-283
Intent to learn, 221-222
Interaction of variables, 29, 641, 643
Interests, attention affected by, 298; development of, 209; effect on marital success, 456-457
Interference, and learning, 249-250
International cooperation and attitude change, 677-685
Interneurons, 44, 46
Interpolation, 357-358
Interpreter effects, 646
Interpreting, opinion polls, 588-589; test scores, 139-145
Interval scale, 616
Intervening variable, 23
Interviews, in opinion polls, 588; personality assessment by, 128-129
Intrinsic motivation, 223, 409-411
Introspection, 20-22; emotion described by, 415-416
Introversion, 124
Involuntary psychotic reaction, 487
Iris, 60
Irradiation, during fetal period, 85; in response, 50-51
Islet preparation, 291
Islets of Langerhans, 63
Isolation, 474
Item analysis, 152

J

James-Lange theory of emotion, 427
Judicial action and delinquency, 582
Jump movements (eye), 262
Juvenile delinquency. See Delinquency

K

Kahn Test of Symbol Arrangement, 133
Kinesthetic sense, 287
Knowledge of results, 229-231; as a motivator, 410. See also Psychological feedback

Known standards, 317
Kohs Block Design Test, 160
Kuder Preference Record, 152-153

L

Labyrinthine sense, 287-288
Language in thinking, 344-345
Latent content, 511
Latency period of libidinal urges, 121
Latent period, 51
Latitude of acceptance, 603
Latitude of noncommitment, 603
Latitude of rejection, 603
Law enforcement, influence on delinquency, 577
Leadership, behavior sampling for assessment, 151; characteristics of good, 566-571; responsibilities of, 562-563; styles of, 563-566; training for, 571
Leadership Evaluation and Development Scale (LEADS), 567-568
Learning, ability, 243-248; and age, 245-248; of attitudes, 189-199; characteristics of material, 225-227; criteria, 203-206; defining, 181-203; discrimination, 191-193; in emotional development, 445-448; environment and, 70; kinds of, 181-200; management of, 221-254; maturation and, 70-74; measuring, 203-209; motivation and, 221-225; motor skill learning, 197-198; neural bases of, 200-203, 666-669; part vs. whole, 236; vs. performance, 208; practice conditions conducive to, 229-239; prior, 227-229; special conditions affecting, 239-242; theories of, 214-218; verbal, 196-197
Learning curves, 206-209
Learning sets, 244-245
Lesions, 54
Level of aspiration, 462
Lewinsohn-Zubin Scales, 118
Libido, 120
Lie detector, 422, 424-425, 426
Life-history methods, 24-26
Light, adaptation, 261; in perception, 316
Likeness, in perception, 303-304
Limen, absolute and difference, 257-258
Linear perspective, 316
Lobotomy, prefrontal, 534
Logical constructs, 23-24
Logotherapy, 512-513
Longitudinal approach in studying growth and decline of human abilities, 106-108
Loudness, 276, 277, 278-279

LSD (lysergic acid diethylamide), 491-492; in therapy, 533
 Lycanthropy, 493

M

Machine-paced, 233-234
 Macro-factors in delinquency, 572-575, 577-578
 Malformation, 86-87
 Man-paced, 233-234
 Manic episodes, 488-489
 Manifest content, 511
 Manikin Test, 160
 Manipulandum, 493
 Manipulation, in infants, 92
 Manual dexterity as a psychomotor ability, 170
 Marijuana, 496-497
 Marriage, adjustment in, 453-458; factors in a happy, 454-458
 Mass action. See Irradiation
 Maturation, and behavior development, 70-72; defined, 70; in emotional development, 445-448; during infancy, 88-93; and practice in athletic skill, 105; and practice in teract, 72; prenatal, 83-88
 Mazes, 198, 199
 Mean, 140, 141, 619-620
 Meaningfulness, and forgetting, 250; of material to be learned, 226-227
 Measurement of personality, 137-178
 Measures of central value, 139-141, 618-620
 Measures of variability, 141-143, 620-624
 Measuring devices, types of, 138-139
 Median, 140-141, 619
 Meier Test of Art Appreciation, 173
 Memory, long-term, 666, 671; as operation, 163-164; as primary ability, 163; short-term, 666, 671; storage of, 202-203, 666-671. See also Retention
 Memory drum, 196
 Memory span, 225-226
 Menarche, 82
 Mental age, 153-154, 166
 Mental disorders. See Neuroses and Psychoses
 Mental health movement, 501-508
 Mental hospitals, 536-538
 Mental retardation, 159, 161; levels of, 158
 Mental telepathy, 332
 Meprobamate, 532
 Mescaline, 491; in therapy, 533
 Mesomorphy, 116
 Metabolism, defined, 62
 Methods of study, 24-35

Micro-factors in delinquency, 572, 575-577, 578-580
 Midbrain, 42, 57, 432
 "Middle-man" hormones, 63-64, 80, 389
 Milieu therapy, 12
 Mind-body problem, 5-6
 Minnesota Rate of Manipulation Test, 170, 171
 Mobility, social, related to delinquency, 572-573; status, and group interaction, 556-557
 Mode, 141, 618-619
 Models, 404-409
 Modes of appearance, 271
 Modes of response, 506
 Monocular perception of depth, 315
 Monozygotic twins, 77
 Moods, 451-452
 Moron, 158, 159
 Morphine, 496, 497
 Morphology, 114-117
 Mothering, 92, 393
 Motion, visual perception of, 318-320
 Motion sickness, 287-288
 Motivation, biological drives as, 377-395; effects on behavior, 376-377; explanations of, 375-376, 655; and forgetting, 250-252; learning influenced by, 221-225; measures of, 138-139; patterns of, 377; psychological and social drives as, 377, 395-411; and work, 409-411
 Motivational research in advertising, 591-592
 Motoneuron, 42, 44, 46
 Motor areas of the brain, 58, 59
 Motor primacy, 82
 Motor skill learning, 197-198; conceptualization and verbalization in, 234-235; distributed practice in, 233-234
 Multiple factor theory, 162
 Multiple personality, 481-483
 Muscle spindle, 50, 51
 Muscles, innervation of, 42; maturation of, 79
 Musical ability, 172-173
 Mutual means as a method of leadership, 564
 Myelin sheath, 46
 Myopia, 268, 269

N

Name calling as a persuasive device, 595-596
 Narcoanalysis, 529-530
 Narcosis, 529-530
 Neanness, in perception, 303
 Near-sightedness. See Myopia

Need achievement score (n Ach), 132, 388-389
 Need integrative therapy, 517
 Needs, psychological and social, 377, 395-411
 Needs and values, and perception, 309-311
 Negative transfer, 227, 228-229
 Negativism, 402
 Neo-Freudian theories of personality, 121-123, 512
 Neonate, 88. See also infants
 Nerve impulses, 46-48, 49
 Nervous system, 41-49, 78-79; role in attention, 296-297; role in emotion, 428-435
 Neural bases of learning, 200-203, 666-671
 Neural patterns, maturation of, 78-79
 Neurasthenia. See Asthenic reaction
 Neurologist, 507
 Neurology, defined, 9
 Neuron, 42; anatomy of, 45-46; kinds of, 46
 Neurosecretion, 385, 655
 Neuroses, 475-485
 Neurotic reactions, 475-485
 Noise, 370
 Nomadism, 470
 Nominal scale, 616-617
 Nomothetic approach to personality, 113-114
 Nondirective therapy, 508-510
 Noradrenaline, 63, 64, 423-424
 Normal distribution, 139, 140, 142, 629-631
 Norms, 138
 Null hypothesis testing, 632-634
 Nutrition in therapy, 533-534

O

Objective observation, 21-22
 Objectivity, 137, 138
 Observation, kinds of, 20-22; and the uncertainty principle, 22
 Observer effects, 646
 Obsessions, 479-480
 Occipital lobe, 55
 Occupational therapy, 537, 538
 Old age, emotional problems of, 452-453
 Old-sightedness, 269
 Olfactory sense, 289-290
 Omissions, 593
 One-tailed test, 633, 634
 One-way screen, 22
 Operant behavior, 216
 Operational definition, 23
 Opponent-process theory of color, 275

- Optic chiasma, 264
 Optic nerve, 260, 266
 Oral period of libidinal urges, 120
 Ordinal scale, 617
 Organ of Corti, 280
 Organic condition, as a factor in perception, 309
 Organism, 39
 Organs of adjustment, 40
 Organs of maintenance, 40
 Organismic theories, 124-125
 Ortho-Rater, 267
 Output, 341-342
 Oval window, 280
 Ovaries, 63
 Overcompensation, as a reaction to frustration, 473
 Overloading the central processor, 676
 Overt behavior, as behaviorists' focus, 7, 216
 Oviduct, 390
 Ovulation, 390
 Ovum, 74
- P**
- Pain, 284-286; as a drive, 391-392; referred, 285; sensitivity in newborn, 86, 89
 Paired associate learning, 196-197
 Panels, in surveys, 590
 Par conditioning, 185
 Paradoxical cold and warmth, 287
 Parameters, 627-629
 Paranoid reaction, 486
 Parasympathetic division of autonomic nervous system, 43, 429-430
 Parent-child relations, delinquency related to, 575-576; and mental illness, 492-493, 504-505
 Parietal lobe, 55
 Partiles, 143, 623-624
 Paternalism as a method of leadership, 564
 Peer group, related to delinquency, 576
 Perception, 300-332; accuracy of, 313; defined, 300; extrasensory, 331-332; of space, 314-321; of time, 321-324; under unusual conditions, 328-331; vigilance and, 326, 327-328
 Perceptual defense, 311, 312
 Performance, and changes in motivation, 209; as criterion of learning, 208
 Performance tests, 155, 160
 Peripheral nervous system. See Nervous system
 Perscveration, 434
 Personal frustration, 461-462
 Personality, approaches to the explanation of, 113-114; body-type theories of, 114-117; clinical methods of studying, 128-134; and delinquency, 577-580; expressive behavior as a clue to, 117-119; and marital success, 456-457; measurement of, 137-178; theories of, 111-135
 Persuasion, devices for, 595-598; factors in effective, 598-607
 Phallic-Oedipal stage of libidinal urges, 121
 Phenomenal field, 125
 Philosophical approach to personality measurement, 145-146
 Phobic reactions, 478
 Photographic memory, 342-343
 Phenology, 115
 Physical methods of therapy, 527-535
 Physiognomy, 115-116
 Physiological, changes during emotion, 423-428; determinants of behavior, 652-656
 Physiological gradient, 82
 Physiological limit, 209
 Physiology, defined, 9; experimental, 6
 Picture completion tests, 155, 160
 Pigments, 272
 Pinal gland, 5, 63
 Pinch, 276, 277-278
 Pituitary, 63-64; and physical development, 79-80
 Place theory of hearing, 280
 Placebo, 29, 530-533.
 Placenta, 84
 Plain folks as a persuasive device, 596
 Plateaus, 207, 208
 Plasticity, 375
 Play therapy, 520-521
 Pleasantness-unpleasantness axis, 418, 419
 Point of indifference, 287
 Polls, employee opinion, 14. See also Public opinion polls
 Positive transfer, 227-228
 Postural reflex, 50
 Postural response, attention as a, 295
 Practice, distributed, 231-234
 Prediction, its role in psychology, 18-20
 Prejudice, appeal to, as a persuasive device, 597-598
 Prenatal, behavior, 84-86; development, 84; effects of unfavorable conditions, 86-88; learning, 86
 Prepotency of stimuli, 297
 Prepsychotic symptoms, 485
 Presbyopia, 269
 Pressure, 283-284
 Pressure differences, 277
 Previous experience, and perception, 306-309
 Primary mental abilities, 161-170
 Primary somatosensory area, 58, 288
 Prime of life, 104
 Principles, 18
 Principles of Psychology, The, 7
 Privileged communication, 507-508
 Probabilistic explanation, 113
 Probability of response as a criterion of learning, 205
 Problem solving, as "gap filling," 357-359; factors in, 361-367; insight in, 353-355; model for, 357; steps in, 355-357; trial and error, 353
 Profile. See Psychograph
 Progesterone, 81-82, 390
 Programed instruction, 237-239
 Projection, as a reaction to frustration, 473
 Projective devices for personality measurement, 129-134
 Propaganda, 594-613; effects of, 607-609; resistance to, 609-612
 Prophylaxis, 502-506
 Protective reflex, 50
 Pseudoconditioning, 185
 Psychedelic drugs, 491-492, 533
 Psychiatric social worker, 507
 Psychiatrist, 12, 507
 Psychoanalysis, 8, 510-512; classical, 120-121; criticisms of, 512
 Psychoanalyst, 507
 Psychoanalytic theories of personality, 119-123
 Psychobiology, 535
 Psychodiagnostics, 12
 Psychodrama, 518-519
 Psychogalvanic response (PGR). See Galvanic skin response
 Psychograph, 174, 175
 Psychological and social motivation, 377, 395-411
 Psychological feedback, 229-231
 Psychological primaries, 270
 Psychological selectivity. See Attention
 Psychological tests, 13, 14, 15; criteria for, 137-138; interpreting scores, 139-145; of intelligence, 153-161
 Psychological zero point, 287
 Psychologists, clinical, 11-13, 507; in government service, 14-15; industrial, 13-14; in private practice, 15-16; psychology of, 645-652; in schools, 13
 Psychology, defined, 8; development as a science, 3-6; methods of study in, 24-35; objectives of, 16-20; relationship to other sciences, 9; teaching of, 10-11
 Psychometrist, defined, 15

- Psychometric approach to personality, 137-178
- Psychomotor abilities, 170-171, 172
- Psychophysical threshold. See *Limens*
- Psychophysics, 6
- Psychoses, 476, 485-494
- Psychosocial development. See *Ego development*
- Psychosomatic medicine, 435
- Psychosomatic reactions, 356-440
- Psychosurgery, 534-535
- Psychotherapy, approaches to, 508-523; characteristics of successful, 523; and clinical psychology, 12-13; evaluating, 523-527; recognition of, 506-508
- Psychotic reactions, 485-494; factors in, 490-493; study of, 493-494
- Puberty, 81-82
- Public opinion polls, 585-590
- Punishment, as an influence on learning, 222-223; as a method of controlling aggression, 407, 466-467
- Pupil (eye), 260
- Pupillary reflex, 262
- Pupillometrics, 425-426
- Purdue Pegboard, 170, 171
- Purkinje effect, 261, 270
- Pursuit movements (eye), 262
- Pursuit rotor, 198
- Pyrimid cortex, 432, 434
- Q**
- Qualitative classification, 17
- Qualitative research in advertising, 591-592
- Quantitative classification, 17
- Quantitative research in advertising, 591
- Quantitative devices for personality assessment, 149-153
- Quartiles, 143, 623
- R**
- Radial motion, 319
- Radiation, and congenital malformations, 87; learning affected by, 242
- Random sampling, 628
- Range, 142, 621
- Rating scales, 149-150
- Ratio scale, 617-618
- Rational psychotherapy, 517-518
- Rationalization, 474
- Raw scores, 139
- Reaction formation, 472-473
- Reaction time, 324-328
- Realistic thinking, 336-337
- Reasoning, 336
- Recall, 210
- Receptive field in retina, 265-266
- Receptors, 41, 44, 45, 46, 258; in hearing, 280; in kinesthesia, 287; in olfaction, 290; in sense of movement, 287; in taste, 289; in vision, 259, 260, 261, 263-264, 266, 274-275
- Recessiveness, genetic, 76
- Reciprocal inhibition, 513
- Reciprocal innervation, 52-53
- Recognition, 210
- Reduction, 352
- Reduction division, 75-76
- Reflexes, adaptive nature of, 50-52; in infants, 91
- Refractory periods, 47
- Regression, 471-472; hypnotic, 522-523
- Reinforcement, 183-184; partial vs. continuous, 183-184; schedules of, 189-190; secondary, 184
- Reinforcement theory of learning, 216
- Relations (in structure of intellect), 163, 164
- Relative motion, 318-319
- Relative position, 316-317
- Relatively refractory period, 47
- Relearning, 210-211
- Relevant variable(s), 27, 28, 636; subject's attitude as a, 30-31
- Reliability, 137, 138
- Religion, and marital success, 453-454
- REM (rapid eye movement) sleep, 330-331
- Reminiscence, 212-213
- Replication(s), in experimentation, 26; in statistics, 642
- Repression, 468-469
- Representative sample, 26, 587-588, 628
- Research in psychology, 12-13, 16-20, 24-35
- Reserpine, 531-532
- Resistance to extinction as a criterion of learning, 205-206
- Resistance to interference as a criterion of learning, 206
- Resistances, analysis of, 511
- Respondent behavior, 216
- Response, as a criterion of learning, 204-206; elicited, 182, 187, 189; emitted, 187, 189; extinction and maintenance of, 189-190; generalization, 184; prenatal, 85
- Retention, 209-214. See also *Forgetting*
- Reticular formation, 56, 57, 296
- Retina, 259, 260, 263-264, 265-266, 274
- Retinal disparity, 315
- Retinal images, 315
- Retreat as an emotional response, 423
- Retroactive facilitation, 249-250
- Retroactive inhibition, 249-250
- Retrograde amnesia, 203; experimental studies of, 666-668
- Reward centers, 435, 531
- Reward conditioning, 187-188
- Rewards, as an influence on learning, 222-223; symbolic, 399-404
- Rhinencephalon, 56, 290, 433, 434
- RNA (ribonucleic acid), 200, 668, 670
- Rigidity, in neurotic behavior, 475, 477; in problem solving, 362
- Risky shift, 552
- Rods, 260, 261
- Rorschach Test, 130-131
- Role learning, distributed practice and, 231-232
- Rudder Control Test, 19
- S**
- Saccule, 287
- Sampling, in opinion polls, 587-588; in statistics, 627
- Sampling distributions, 631-632
- Sampling theorem, 675
- Saturation, 270, Color Plate I
- Scapagoating, 464
- Schemata, 308
- Schizophrenia, 486, 487, 489; chemical factors in, 491; contrasted with multiple personality, 482; diagnosis of, 493; and heredity, 490-491; and parent-child relations, 492-493; therapy for, 514-515, 519, 532
- School phobia, 478
- School Vision Tester, 267
- Science, development of, 4-5
- Sclera, 259
- Scopolamine, 529
- Scores, defined, 17; statistical interpretation of, 139-144, 616-644
- Scotoma, 270
- Secondary somatosensory area, 58, 288
- Self-actualization theories, 125-127
- Self concept, 112, 125; of delinquents, 578-579
- Self-exciting circuits, 49-50
- Self-inventories, 151-153
- Self-stimulation of the brain, 435
- Semantic content (in structure of intellect), 163, 164
- Semicircular canals, 287
- Semistatvation, effects of, 382-383
- Sensation, 257-293; general characteristics of, 257-259
- Senses, adaptation of, 258; areas of the brain related to, 288; cutaneous, 283-288; development in in-

- fants, 88-90; gustatory, 290-292; hearing, 277-283; interaction of, 313-314; kinesthetic, 287; labyrinthine, 287-288; olfactory, 289-290; retention of experiences of, 258-259; vision, 259-277
 Sensitization, 185-186
 Sensory aphasia, 60
 Sensory deprivation, during infancy, 95-96; effect on animals, 96-98; perceptual changes after, 328-331
 Sensory feedback, 41, 340-342
 Sensory-motor arc, 41, 42, 44-45, 46
 Sensory (afferent) neuron, 42, 43, 44, 45, 46, 57
 Septal region of the rhinencephalon, 432, 433-434
 Serial learning, 196-197
 Serial position effect, 246
 Servomechanisms, 341-342
 Set, learning, 244-245; mental, 361-363; toward action, 296
 Sex, as a biological drive, 389-391; determination of, by chromosomes, 76-77; differences in intelligence, 168-169; drive, sublimation of, 472
 Shadow, in perception, 316
 Shaping, in instrumental conditioning, 188
 Shock therapy, 527-529
 Sibling, 77
 Sight Screener, 267
 Sigma, 324, 620
 Signals, 369-370
 Signal characteristics, learning of, 673-674
 Situational effects, 647
 Size constancy, 317
 Skewed curve, 140-141
 Skinner's approach to learning, 215-216
 Skinner box, 187, 192
 Sleep, kinds of, 330-331, 653-654; learning during, 241-242; need for, 356-388
 Smell, development of, in infants, 88-89; sense of, 289-290
 Smoking, and premature delivery, 87
 Snellen chart, 267, 268
 Social development, in infants, 92
 Social facilitation, 551
 Social motives. See *Psychological and social motivation*
 Social perception, 566-568
 Social stimulus value, 111-112
 Social suggestion, influence on perception, 312-313
 Socioeconomic status and delinquency, 572-573
 Sociology, defined, 9
 Sociotherapy, 537
 Sodium amytal, 529
 Sodium pentothal, 529
 Somatosensory areas, 58-59, 288
 Somatotypes, 116-117
 Somesthesia and the brain, 58, 288
 Soul, 9
 Sound, perception of, 320-321; physical and psychological bases of, 277-279. See also *Hearing*
 Sound waves, 277-281; properties of, 276
 Space, perception of, 266, 314-321
 Spectrum, 270
 Speech, areas of the brain, 6, 60; in infants, 92-93
 Speed of arm movement as a psychomotor ability, 171
 Speed of response as a criterion of learning, 205
 Sperm, 74
 Spike potential, 48
 Spinal cord, distributing system of, 49-50, 51
 Spinal reflex action, 49-53
 Split brain experiment, 61-62, 191
 Split personality. See *Schizophrenia*
 Spontaneous movements, during fetal period, 85
 Spontaneous potentials, 339
 Spontaneous recovery, 183, 189
 Stabilized image, 262-263
 Stage of exhaustion, 440
 Stage of resistance, 440
 Standard deviation, 142-143, 621-622
 Standard error of the mean, 631
 Standard score (z score), 142, 143, 622-623
 Standardization, 137, 138
 Standardized interview, 129
 Stanford-Binet, 154-156
 Starvation, effects of, 382-383
 Statistics, basic concepts in, 137-145, 616-646; descriptive, 139-145, 618-627; inferential, 626-644
 Statistical analysis, 31
 Statistical control, 31
 Statistical significance, 632
 Status, effects of, in group, 555-558
 Status contagion, 593
 Stereoscopic principle, 315, 316
 Stereotyped behavior in learning, 224
 Stereotypes, 128-129
 Stimulants, effects on memory storage, 669-671
 Stimulated movements, during fetal period, 85
 Stimulation method of studying the brain, 54, 381, 433-434
 Stimulus, defined, 40; intensity, 257-258; role of, 40-46
 Stimulus control, 193
 Stimulus field, factors influencing perception, 303-306
 Stimulus generalization, 184, emotional development and, 443-444
 Stimulus-response theories, of learning, 215-216; of personality, 127
 Stirrup, 279, 280
 Stopping of emotional response, 423
 Strength of response as a criterion of learning, 205
 Stress, as an influence on learning, 223-225; in problem solving, 365; and physiological reactions, 416-417, 436-441, 656
 Stressor, 440
 Stretch reflex, 50, 51
 Strong Vocational Interest Blank, 152, 409
 Structural connections, 78
 Structuralists, 7
 Structure of intellect, 163-165
 Structures, thinking in, 359
 Structuring the situation, 562-563
 Study of Values test, 145-146
 Subcortical functioning in emotion, 432-435
 Sublimation, as a reaction to frustration, 472
 Subliminal, defined, 257
 Subliminal stimulation, learning under, 240-241
 Substitution, as a reaction to frustration, 472
 Successive approximation, 188
 Suicide, 464-466
 Summation, temporal and spatial, 52
 Superego, 120
 Suppression, 469
 Survey method of study, 26
 Surveys. See *Public opinion polls*
 Symbolic content (in structure of intellect), 163, 164
 Symbolic rewards, 399-404
 Symbols, 347. See also *Thinking*
 Sympathetic division, 43, 428-429
 Synanon, 497
 Synapse, 48-49
 Synesthesia, 314
 Systematic desensitization, 513
 Systems (in structure of intellect), 163, 164

T
 t ratio, 634
 Tabes dorsalis, 342
 Tahoos, influence on perception, 311-313
 Tachistoscope, 311, 312
 Tarnatism, 493
 Taraxacin, 491
 Taste, area of the brain, 291-292; development in infants, 88; sense of, 290-292
 Taste buds, 290
 Teaching machines, 238-239

- Teleological explanation, 113
 Telephone theory of hearing, 281
 Temperament factors, 146, 147-149
 Temperature, regulation, 388-389, 654; sense of in infants, 89; sensitivity to, 286-287
 Temporal lobe, 55
 Testes, 63, 81
 Testicular androgens, 81, 389
 Tests. See *Psychological tests*
 Texture, in perception, 316
 Thalamus, 56, 57, 288
 Thematic Apperception Test (TAT), 131-133, 396
 Theories of learning, 214-218; of personality, 111-135
 Theory, defined, 18
 Therapy, eclectic approach to, 535-538; physical methods of, 527-535; trends in, 537-538. See also *Psychotherapy*
 Thinking, informational approach to, 351-352; kinds of, 335-338; muscular activity in, 339-340; simple forms of, 337-338; tools in, 342-352
 Thirst drive, 384-386
 Threshold, 47, 257
 Throughput, 341-342
 Thurstone's seven factors of intelligence, 162-163
 Thymus, 63
 Thyroids, 63, 64; and physical development, 80
 Timbre, 276, 277, 279
 Time, perception of, 321-324
 Tinnitus, 282
 Tone deafness, 283
 Touch, sense of, 283-284; in infants, 89
 Traits, hermetic, 146-147; temperament, 146-149
 Tranquilizers, 531-532
 Transfer and testimony as a persuasive device, 596
 Transfer, 227-229
 Transference, in psychoanalysis, 511-512
 Transformations (in structure of intellect), 163, 164
 Transitional areas and delinquency, 574
 Transitional cortex, 432
 Transmitter, 369
 Trial and error in problem solving, 353
 Twins, 77, 165-167, 490-491
 Two-tailed test, 633
 Two-way analysis of variance, 641-644
- U**
- Uganda children compared with Western, 98-99, 100
 Ulcers, emotional factors and, 436-437, 656
 Unbiased estimate, 629
 Uncertainty principle, 22. See also *Observer effects*
 Unconditioned response (UCR), 182
 Unconditioned stimulus (UCS), 182
 Unconscious mental processes, 8, 120-121, 124
 Unloading the central processor, 676
 Understanding, as an objective of psychology, 16-18
 Understanding the whole person, 174-176
 Undoing, 474
 Units (in structure of intellect), 163, 164
 Utricle, 287
- V**
- Validity, 137-138
 Values, development of, 408-409, 573
 Variability, measures of, 141-143, 620-624
 Variables in experimentation, 27-31
 Variance, 621; analysis of, 635-640
 Ventral column (of the spinal cord), 49
 Ventromedial nucleus, 433
 Verbal learning, 196-197
 Vestibular receptors, 287
 Vigilance, perception and, 326, 327-328
 Vincent curve, 350
 Violence, influence of portrayed, 405, 576-577
 Virilism, 80-81
 Visceral nervous system, 428-431
 Visceral sensation, 430-431
 Visible speech, 282
 Vision, 259-277; acuity of, 263-270; anatomy of the eye, 259-260; color blindness, 275-277; detects of, 268-270; development in infant, 89-90; eye movements in focusing, 261-262; theories of color, 274-275
 Visual, distortion, 317-318; perception of motion, 318-320; perception of stationary objects, 315-317
 Visual acuity, 263-270; measuring, 266-268; neural basis of, 263-266
 "Visual cliff" device, 302, 303
 Visual pathways, 265-266
 Vocal expression of emotion, 418, 420
 Voiceprints, 118, 119
 Volley theory of hearing, 281
 Volume, 276, 277, 278-279
- W**
- Warmth, 286-287, 388-389, 654
 Wave length, and hue, 270; and pitch, 276, 277-278
 Weber's law, 258
 Wechsler Adult Intelligence Scale (WAIS), 155
 Wechsler Intelligence Scale for Children (WISC), 155
 Weightlessness, 15
 Wernicke's center, 60
 Withdrawal reactions, 468-472
 Withdrawal reflex, 391
 Withdrawal therapy, 497
 Within variance, 636, 637, 639
 Worry, in college students, 451; development of, in children, 448-449
 Wrist-finger speed as a psychomotor ability, 170
 "Wrong way" pathways, 296
- X**
- X chromosome, 76-77
- Y**
- Y chromosome, 76-77
 Young-Helmholtz theory, 274
- Z**
- Zeigarnik effect, 250-251
 Zygote, 74